



THE MARINE MAMMALS

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The chances of spotting a marine mammal while walking the decks of a BC ferry or wandering the shorelines of the Strait of Georgia are extremely high today, but it wasn't always this way. The harbour seals that are now so common were once heavily culled and were seldom seen for most of the 1900s, while all the humpback whales that once fed in Howe Sound and elsewhere in the strait were slaughtered by commercial whalers stationed near Nanaimo. Even the rare Steller sea lions were hunted for sport—and killer whales were up for sale, as commercial interests sought to capture and send them alive to aquaria and marine parks for public display. All of this changed in British Columbia, however, with the end of whaling in the late 1960s, the protection of marine mammals under the Canadian *Fisheries Act* in 1970 and an end to capturing killer whales in the mid-1970s.

Today the Strait of Georgia is home to the highest density of harbour seals in the world, and has seasonally abundant California sea lions and Steller sea lions. Dall's porpoise, Pacific harbour porpoise, Pacific white-sided dolphins and killer whales are also seen with increasing regularity. Rarer species include minke whales, grey whales, humpback whales and northern elephant seals. At least eleven species of marine mammals are readily found in the Strait of Georgia, of which many live here year-round while others are seasonal visitors.

The diversity of marine mammals that make the Strait of Georgia their home can be explained by the variety and abundance of prey, the productivity of the marine ecosystem, and the range and complexity of the habitats they are well equipped to live in and exploit. The Fraser River is one of the most productive river systems in the world, and draws large numbers of marine mammals intent on feeding on returning adult salmon in the fall, or intercepting outward migrating salmon smolts in the spring and summer. Seasonal pulses of spawning herring and eulachon also attract large numbers of marine mammals in the spring to feed on the lipid-rich concentrations of fish. These seasonal pulses of aggregated prey result in peaks and valleys in the numbers of marine mammals present at any one time in the Strait of Georgia. Densities peak twice each year—once in the autumn and higher again in the spring—and are lower in summer and lowest in winter. These two seasonal peaks in numbers reflect the addition of animals from the outer waters of BC and the USA to the resident populations of individuals that live and feed year-round in the strait.

Opposite: Steller sea lions are regular visitors to the Strait of Georgia, particularly during spring when herring spawn. The largest species of sea lions in the world, mature bulls can weigh over one ton and are two to four times heavier than adult females.

A.W. Trites photo

In terms of numbers, seals and sea lions are the most abundant marine mammals in the Strait of Georgia, followed by porpoises, dolphins and baleen whales.

Seals and Sea Lions

The seals and sea lions that dominate the Strait of Georgia are also known as pinnipeds (their Latin name meaning “fin-footed”). They travel and forage throughout the strait (and even enter some rivers and lakes), but require a solid substrate to give birth and suckle their young. They may watch a passing beachcomber from the safety of the water, and are usually seen sleeping and resting in groups on land or on floating structures such as docks and logs—where they can conserve body heat and reduce the risk of being taken by killer whales.

Four species of pinnipeds live in the Strait of Georgia—of which two are phocids (true seals) and two are otarids (sea lions). The easiest way to distinguish between the two families of pinnipeds is by their ears. Otarids, such as California and Steller sea lions, all have small external ear flaps—while the phocids, such as harbour seals and northern elephant seals, have uncovered openings to their ear canals that literally look like holes in their heads. Other distinguishing differences are their flippers and the ways in which they swim and move on land. The phocids all have short fur-covered flippers and swim using alternating side-to-side strokes of their rear flippers. In contrast, the otarids have hairless flippers and pull themselves through the water with their large powerful front flippers as if using wings to swim.

Otarids have extremely flexible spines that allow them to bend their necks backwards like a gymnastics contortionist to touch their hind flippers. Otarids are also able to rotate their hind flippers under their bodies to support their weight and walk on all fours like a bear—whereas the phocids

are unable to walk, and must instead undulate and bounce to move on land while pulling their bodies forward with their short and stubby clawed-front flippers. As a result, phocids tend to stay close to the water’s edge and use low haulout sites that facilitate exiting and entering the water, while otarids can climb steep rocky outcroppings high above and away from the water. Haulout patterns of phocids also tend to be more tidally dependent than otarids, with greater numbers out of the water on low tides.

The regularity and predictability with which pinnipeds can be found at certain haulout sites makes it relatively easy to monitor their numbers and diets. The populations are censused every two to five years by flying a small plane over the known haulout sites and photographing the numbers hauled out. Flying times are coordinated with weather conditions and tide heights to ensure seeing peak numbers on land—and mathematical correction factors are later applied to account for the proportion of animals that were likely at sea during the survey. Diets are determined from fecal remains (scats) collected at haulout sites.

Pinniped scats (feces) contain DNA of the prey eaten, as well as bones and other hard parts that can be identified by species and measured to estimate the size of prey. In general, the diets of seals and sea lions in the Strait of Georgia are similar to each other—and overlap significantly with the types of fish that people also value. Pinniped diets are diverse and show seasonal and species-specific preferences for herring, salmon, Pacific hake, eulachon, rockfish, squid, octopus, walleye pollock, flat fish, Pacific cod, ling cod, spiny dogfish, surfperch, sculpins and plainfin midshipman. These are the most frequently consumed fish and invertebrates, although pinnipeds also occasionally eat a number of other species.



Two adult harbour seals bask in the afternoon sun.

A.W. Trites photo

Harbour seals (*Phoca vitulina*)

Harbour seals are relatively small and vary in patchy colours of blacks, browns, greys or tans. Each individual has a unique pelage (fur colour pattern)—just as no two people have the same fingerprint. These mottled coats often help to camouflage the seals as they lie and rest in the intertidal zones. Mature males (1.4–1.9 m, 55–170 kg) tend to be larger than females (1.2–1.7 m, 45–105 kg), but do not live as long (20–25 years versus 30–35 years). They have little social organization or interaction with each other compared to other species of pinnipeds, although presumably find safety in numbers by hauling out together.

Widely distributed throughout the Strait of Georgia, harbour seals even inhabit some of the bodies of fresh water that flow into the strait. They haul out onto rocky shores, mud flats, sandbars, tidal reefs, sandy beaches, log booms and boulders—and can also sleep underwater on the bottom of shallow bays. They do not migrate, but may move seasonally to take advantage of abundant prey such as spawning salmon

and herring. Overall, harbour seals tend to travel no more than 20 km from shore. They make short regular dives, usually to less than 100 m, to capture fish, cephalopods (squid and octopus) and invertebrates (crabs and shrimp).

Harbour seals only give birth to a single pup, as do all pinnipeds. Weighing about 6 kg, the pups are born in an advanced stage of development that allows them to flee their birthing sites at a moment's notice. Pups are almost always born with an adult coat of hair, having already shed their first coat of long, silvery white hair while in the uterus. This allows them to follow their mothers into the water and swim within hours of birth. Afterbirth (placentas) can often be found in the intertidal zone and can usually be identified for harbour seals by the thick matt of hair contained inside. Females usually pup at or near the sites they regularly use to haul out, although will tend to distance themselves from other animals. Breeding males, however, are usually lurking nearby in the water waiting for moms to wean their pups and be bred again.

Most harbour seal pups are born in the Strait of Georgia from July to early September, which is about one to two months later than in California, Alaska, Russia and Japan. This curious difference in timing of births corresponds to genetic differences related to two periods of colonization by harbour seals that came to the North Pacific from the Atlantic Ocean through an ice-free Arctic. The ancestors of the seals that live in the Strait of Georgia make up most of the descendants of the first harbour seals to arrive in the North Pacific Ocean 670,000 years ago, while all of the remaining seals that range from California to Japan can trace their ancestry to the second invasion of the North Pacific 380,000 years ago.

Another curious holdover from the past is the timing of pregnancy. Birth and sex follow within weeks of one another (at the end of weaning for phocids and about one week after birth for otarids), but fetal growth takes only 7–8 months. Pinnipeds manage this feat using a system of delayed implantation whereby the fertilized egg divides and becomes a hollow ball of cells (the blastocyst) over the next five days before sitting dormant for 3.5–4 months—at which point it will move to one of two uterine horns and implant in the wall of the uterus and begin to grow. This allows the pinnipeds to get together just once a year to focus on reproduction.

Pinnipeds, like all marine mammals, have teats (two for phocids and four for otarids) and nurse their newborns with lipid-rich milk. Pups typically suckle about 15 minutes every three hours, and are quick to grow and fatten. In the case of harbour seals, the pups do not socialize with other pups, and will receive milk for 5–6 weeks—after which they will be abandoned to transition on their own to find and eat fish and invertebrates. Mothers stay with their pups and keep careful watch over them during the nursing period—and are seldom far away from the loud “mwaa” calls of their pups,

which can be heard more than a kilometre away. Mothers rely on sound and smell to recognize their pups. However, the adult harbour seals are quiet (the least vocal of all pinnipeds) and will at best snort or growl when threatened. The only other harbour seal sound usually heard from August to October resembles a gunshot. This telltale sound is made by males that violently slap the water surface with their hind flippers to alert potential mates and warn male competitors of their presence and size. Courtship and mating occurs in the water after the pup has been weaned and the female has come into estrus.

The numbers of harbour seals that haul out on a daily basis is related to the timing of the low tides, the air temperature, the strength of the winds and the levels of rainfall (pinnipeds don't like driving rain). Given their druthers, harbour seals appear to prefer to haul out at midday or early afternoon to catch the warm rays of the sun. They will often haul out as a tide is falling and can often be found asleep atop boulders or on precarious perches once the water has receded. They are also capable of sleeping on the bottom of shallow bays. While on land, they are easily disturbed by people or animals approaching too closely, and will quickly re-enter the water. On average, harbour seals spend about two-thirds of their day in the water and one-third on land.

Numbers hauled out are typically highest in the fall when the seals are moulting their old coats and replacing the broken and damaged hairs with new ones. This period of skin cell maintenance is energetically costly and would result in greater heat loss if done in the water. All pinnipeds go through an annual moult, which is usually completed in a rapid few weeks for phocids and a gradual 1–2 months for otarids.

Harbour seals were once valued for food and clothing by First Nations—and later despised as a nuisance and competitor of

fisheries. The belief that seals were negatively affecting commercial salmon fisheries led to the killing of 200,000 to 240,000 seals throughout British Columbia from 1913 to 1964 under a bounty program paid for by the Canadian government. Bounty hunters were required to turn in the snouts of the seals they killed to ensure that the whiskers had the telltale spiral ridge of harbour seals and were not the snouts of dogs or other animals. There was also a short-lived hunt for seal pelts (1962–1968), which did not leave many seals in the Strait of Georgia by the time they were protected in 1970 under the Canadian *Fisheries Act*.

The harbour seal population in the Strait of Georgia is believed to have numbered fewer than 2,000 individuals when culling and commercial hunting were stopped. Once protected, the seals recovered at an exponential rate—numbering about 5,000 through the 1970s, 15,000 in the 1980s, and around 40,000 since the mid-1990s. The Strait of Georgia population appears to have reached carrying capacity and returned to pre-exploitation levels, although there is no sign of malnourished seals or any indication that their numbers are being limited by food shortages. Instead it appears that the harbour seal population has been lowered and is being kept in check by predation from transient killer whales—the type of killer whale that only eats other marine mammals. Despite this constant removal by killer whales, the Strait of Georgia boasts the healthiest and densest population of harbour seals anywhere in the world.

The extent to which harbour seals negatively affect salmon stocks is unknown, although it is believed that large run sizes mitigate the most serious population level impacts of seals—given that the most a seal can ingest in a day is a rather small stomachful of salmon. Less certain is whether the seals are eating significant numbers of salmon smolts that are flowing down the rivers and spending parts of their life cycles

in the Strait of Georgia. It is also unclear the extent to which harbour seals may be benefitting salmon by eating fish species that prey on salmon smolts, such as hake and sculpins. Much remains to be learned about the role that harbour seals play in the health and functioning of the Strait of Georgia marine ecosystem.

Northern elephant seal (*Mirounga angustirostris*)

Many people are probably unaware that there are elephant seals in the Strait of Georgia—and probably no one would have known the importance of this area to them had they actually gone extinct. Northern elephant seals are the largest of the northern hemisphere pinnipeds—males weigh more than 2,000 kg and are 4 m long; females are more than 600 kg and 3 m long—and were heavily hunted in the 1700s and 1800s for the valuable oil in their blubber. Northern elephant seals were believed to have gone extinct sometime in the late 1800s, so it was of great surprise when a group of biologists from the Smithsonian Institute discovered a remnant population of eight individuals on a remote island off the coast of Mexico in 1892. However, rather than record this remarkable discovery in their field notebooks, this team of biologists took aim and killed seven of the eight elephant seals to provide their museum with the last record of this species having existed. Fortunately, the one that escaped joined as many as 50 to 100 other undiscovered elephant seals—and set the stage for an amazing population recovery.

From this small bottleneck population, northern elephant seals have re-established breeding populations in Mexico and California—and have restored their traditional migratory routes to British Columbia, the Gulf of Alaska and Aleutian Islands. They have increased at a rate around 6 percent per year and now number about 200,000 animals.



Adult male northern elephant seals can often be found moulting at Race Rocks during July and August.

A.W. Trites photo

Pupping and breeding occurs in December and January, and is restricted to seven principal areas in Mexico and California. However, a small number of pups have been born in recent years at the Race Rocks Ecological Reserve near Victoria—raising the possibility that British Columbia could one day become the eighth and most northerly breeding site of elephant seals in the world. In January 2009, the first elephant seal pup was born near the base of the lighthouse on Race Rocks, and a second was born one month later. As of 2014, at least eight pups have been born at Race Rocks.

Breeding bulls can fast for three months during the winter breeding season, while the females typically fast for five weeks while nursing their pups. All adults will depart following breeding to feed, and will return to land a second time to moult in spring or summer. Elephant seals have an unusual annual moult that entails not only shedding their hair, but also shedding the upper layer of their skin. Large patches of hair and skin literally fall off the animal

within weeks, leading some people to call animal rescue facilities in the belief that the animal lying catatonically on the beach is sick or dying. The elephant seals will lose considerable body weight for three to five weeks as they live off their blubber reserves, conserve body heat, and regenerate new skin and hair. This is a normal part of the elephant seal's life cycle. What is less normal in recent times is the increasing frequency with which moulting elephant seals are being observed around the shores of the Strait of Georgia and elsewhere in BC.

Other than the observations by Pearson College from the lighthouse at Race Rocks, no official records are maintained in Canada of elephant seal sightings in British Columbia. Yet the few people who have seen them in the Strait of Georgia while kayaking or boating often recount their experience as having seen a sea monster. For what often appears at first glance to be a huge floating deadhead log can turn out to have a giant nose (an exaggerated proboscis) and a glaring set of large eyes that

shows no sense of fear or urgency to disappear. Sightings of these sea monsters have come from such places as the entrance to Departure Bay in Nanaimo, in the waters around Bowen Island in Howe Sound, and even from a small passenger ferry as it crossed from Granville Island to downtown Vancouver.

The small numbers of elephant seals seen each year in the Strait of Georgia have come from the breeding colonies in Mexico and California, and possibly now from the Race Rocks Ecological Reserve. The average elephant seal swims between 18,000 and 21,000 km each year as they migrate twice a year (once after breeding in winter, and once after moulting in spring and summer) to the northern and offshore feeding areas.

Those elephant seals that come to the Strait of Georgia occur primarily in the deepest waters feeding on deep-water squids, rat fish, Pacific hake and small sharks (dogfish). They do not interact with fisheries and go largely unseen, spending an average of 20 minutes per dive at depths of 350 to 700 m. Elephant seals generally do not feed in less than 200 m of water, and can stay underwater for as long as two hours at depths exceeding 1,500 m. Pinnipeds such as elephant seals have excellent underwater hearing and vision (to see bio-luminescing prey), and have vibrissae (whiskers) that are extremely sensitive to vibrations, which help to track down prey that have passed by and disturbed the stillness of the water column.

Other elephant seals found moulting on Race Rocks and other sites around the Strait of Georgia appear to have elected not to swim all the way back to California and Mexico for this annual ritual. Timing of moulting varies by age and sex, with females and juvenile males moulting first in April to May, followed by subadult males from May to June, and adult males in July and August. Encounters with moulting elephant seals are likely to increase with time

as their populations continue to increase and they fully recolonize their traditional foraging and moulting areas.

Steller sea lions (*Eumetopias jubatus*)

The Steller sea lion is the largest otarid, and the only one that breeds and resides year-round in Canadian waters. Adult males weigh 400–800 kg on average and are two to four times heavier and 20–25 percent longer than adult females. The maximum length of adult males is about 2.7–3.1 m compared to females that are 2.1–2.4 m and weigh 200–300 kg. They are tawny brown when dry and appear a greyish dark brown when wet. The large size of the males allows them to fast and defend territories needed to breed with females that stay within their harems during the summer breeding season. Males are notable for their rounded bear-like heads, their lion-like roars and their thick necks covered in longer fur that resembles a lion's mane. Longevity is about 14 years for males and 22 years for females, and average age of breeding animals (males and females) is 10–11 years old.

Pups are born at rookeries from late May to early July and weigh 16–23 kg at birth. They will stay with their mothers for one to three years. There are five rookeries in British Columbia—all located on exposed outer islands—well beyond the protected waters of the Strait of Georgia. About 60 percent of the Steller sea lion population can be found at rookeries during the summer (including pups), while the remaining 40 percent continue to use haulouts. By late summer to early fall, mothers and their pups will have left the exposed rookeries and moved to more protected waterways such as the Strait of Georgia. Steller sea lions are typically found within about 15 km of shore during summer, but can range over 200 km from shore in winter. They are non-migratory, but may disperse considerable distances from rookeries.

Steller sea lions found in the Strait of

Georgia were most likely born on the Scott Islands at the northern tip of Vancouver Island—the closest rookery to the Strait of Georgia and the largest breeding concentration of the species in the world. Others may have come from two smaller rookeries in Oregon State (there are no rookeries in Washington State). Most of the Steller sea lions in the Strait of Georgia are subadult males and bulls that are drawn here in the spring to fatten on the spawning herring. Bigger and stronger bulls will be better equipped to hold a territory and mate with more females when they return to the rookery in early summer. However, increasing numbers of mothers and juveniles have begun using the Strait of Georgia as the population has recovered from the effects of hunting and culling—and some may take up year-round residency as their numbers continue to grow.

From 1910 to 1970, predator-control programs and commercial hunting (for mink food) killed over 50,000 Steller sea lions at rookeries and haulouts, and caused the extinction of two of the five existing breeding sites. Even the Canadian Air

Force and Navy are believed to have gotten in on the action and killed significant numbers by dropping explosives on them during World War II bombing practices. By the time Steller sea lions were protected in 1970, they were about one-quarter of their original numbers and a relatively rare sight in British Columbia. Their numbers continued to remain low with little sign of any recovery until 1990.

Since 1990, Steller sea lions have increased in British Columbia at an exponential rate and number about 35,000 during the breeding season. Numbers increase during winter to about 50,000 with the arrival of animals dispersing from Southeast Alaska and Oregon. British Columbia appears to be an important feeding area as they hunt for herring, hake, sand lance, salmon, spiny dogfish, eulachon, sardine, rockfish, flounder, skate, squid and octopus. The Steller sea lions that are drawn to the Strait of Georgia in winter and spring appear to primarily target herring, with most returning to the outer coast in early summer for the start of the breeding season.

Adult male Steller sea lions commonly rest among the much smaller juveniles and adult female sea lions as in spring at this haulout near Hornby Island.

A.W. Trites photo



The rise in sea lion numbers in British Columbia is in sharp contrast to their decline in Russia, the Aleutian Islands and Gulf of Alaska where over 85 percent of the Steller sea lions have disappeared since 1980. Research into the population decline has revealed differences between the divergent populations in terms of skull morphology (skull shapes) and genetics of individuals breeding in the two regions. As a result, two subspecies of Steller sea lions are recognized: *E. j. jubatus* (Asia, Aleutian Islands and Gulf of Alaska) and *E. j. monteniensis* (Southeast Alaska, British Columbia, Washington, Oregon and California). These two subspecies are commonly referred to as the western and eastern populations of Steller sea lions.

What underlies the declines and increases in Steller sea lion populations is a perplexing mystery that cannot be explained by hunting and culling, or by the movement of animals. One hypothesis is that the decline of the western population was driven by overfishing, which reduced the quantity of prey available to sea lions, and in turn reduced body growth, birth rates and ultimately survival. However, an alternative hypothesis is that the decline was due to increases in the abundance of low-quality prey that reduced the birth rates of sea lions. Mounting scientific evidence is indicating that the decline of the western population and increase of the eastern population are natural and related to changes in quality of prey consumed. Historically, sea lions in British Columbia ate predominately low-calorie species, such as cod, pollock, hake and rockfish in the 1950s and 1960s—and now consume greater amounts of high-energy species such as herring, sand lance and sardines. The opposite is true in Alaska. It appears that Steller sea lions need high-octane food to fuel their high metabolisms because they can get full eating low-energy species before they have eaten enough to meet their daily

energy needs. However, debate continues over the relative influence of natural fluctuations versus anthropogenic effects associated with climate change, whaling and commercial fisheries.

Killer whales may also be playing a role in the decline of the western population of the sea lions. In general, food is thought to regulate Steller sea lions and other high trophic-level predators through bottom-up processes that limit the availability of prey. However, it has been hypothesized that some populations may be limited by top-down processes, such as predation by killer whales (which may have stopped the population growth of harbour seals in the Strait of Georgia). Although detailed data on killer whale predation rates are lacking, it is possible that predation by killer whales could be keeping depressed populations of Steller sea lions down.

In the Strait of Georgia, Steller sea lions can be most easily seen in winter and spring hauled out on low, exposed rocky reefs. They may also be seen on floats, log booms and buoys—and are often mixed with California sea lions. Adult male sea lions are easier to approach and observe than juveniles. However, all Steller sea lions are easily startled and will quickly stampede into the water if surprised and threatened. The key to getting near them is to allow them time to become aware of approaching vessels and people, and for people to avoid making loud noises or sudden movements.

California sea lion (*Zalophus californianus*)

California sea lions are often confused with Steller sea lions, but are much smaller and darker in colour than Stellers. Adult California males are about 2–2.5 m long and weigh 200–400 kg, whereas females are only 1.4–1.7 m and 70–110 kg. Males also tend to be a darker brown than females and juveniles (which have a dark tawny brown fur) and appear almost black when wet.



Small numbers of adult male California sea lions frequent southern BC waters from fall to spring before returning in summer to breed in California and Mexico.

A.W. Trites photo

Pups weigh about 6–9 kg at birth and are born in California and Mexico.

Compared to Steller sea lions, the snouts of California sea lions are longer and narrower, and the manes of the bulls are less developed. Another distinguishing feature of male California sea lions is the box-shaped forehead of bulls, called a sagittal crest, which is usually tufted with a patch of fur that gets lighter in colour with age. This bony ridge on top of the male's skull begins to develop around five years of age. Another distinguishing difference between the two species of sea lions is their calls. If it roars and growls like a lion, it's a Steller sea lion—but if it barks like a high-pitched dog, it's a California sea lion!

For the most part, only adult and sub-adult male California sea lions occur in British Columbia; the females are rarely seen. The males typically arrive in the fall (September–October) and depart for California and Mexico in the spring (April–May) in time for the summer breeding season (May–July). They occur in the Strait of

Georgia and have been reported from virtually all of the coastal waters of Vancouver Island. One theory for the separation of sexes during the non-breeding season is that the waters of British Columbia are too cold for the relatively tiny females and their pups to tolerate. Another is that the risk of a male being eaten by a great white shark is lower in BC, and that males have a better chance of meeting their higher caloric needs by migrating north to feed, rather than staying near the southern breeding colonies. However, neither explanation brings much solace when the quiet of the coastal waters of the Strait of Georgia is broken by the arrival of the loud incessant barking of the California sea lions. They just never seem to shut up.

California sea lions are very social animals and often haul out amongst Steller sea lions. They prefer to rest closely packed together at favoured terrestrial sites or on man-made structures such as breakwaters, docks, log booms and boats. California sea lions will also form "rafts" where no suit-

able haulout sites are available, and float in groups with their flippers held out of the water to reduce heat loss. While out of the water, they typically sleep or may engage in mock battles with other males, or may simply be content to scratch themselves with the “toe” nails on their hind flippers, or rub their fur with their fore-flippers, or simply rub against rocks and other sea lions.

Both California and Steller sea lions swim at speeds around 10 km/h and dive for less than three minutes on average to depths that are typically less than 80 m. They are capable of diving deeper (up to 300 m) and longer (up to 10 minutes), and swimming at faster speeds if necessary—but cannot do so sustainably. Sea lions see the world in tones of blues and greens, which is likely an adaptation to living and feeding in the water. They are efficient at grabbing prey with their teeth and sucking them down whole, or can bring larger individuals to the surface to break apart—often to remove the bony heads—and swallow them in large chunks. Like all pinnipeds, they do not chew their food before swallowing. Sea lions have also been observed to swim into balls of schooling herring and sand lance, and swat them with their front flippers—after which they turn back to eat the stunned, spinning, individual fish. Sea lions can be seen feeding alone, or in small groups of 2–10 individuals. Their diets consist mostly of mid-water schooling fishes such as herring, sand lance, hake, pollock dogfish and salmon. Cavorting sea lions are also known to take fish that escape from feeding humpback whales.

Heavily culled and exploited in the nineteenth and twentieth centuries, California sea lions have increased in numbers since being protected in 1972 under the US *Marine Mammal Protection Act*. Today, the population, which may be at carrying capacity, numbers about 350,000, of which 2,000 to 10,000 males spend part of each year in British Columbia. Numbers of Cal-

ifornia sea lions in British Columbia vary from year to year due perhaps to fluctuations in the abundance of prey encountered here or elsewhere during their migration. Based on bones found in middens, California sea lions were historically consumed by First Nations people and did not reappear in British Columbia until the breeding colonies began to recover off California in the early 1970s.

California sea lions are considered a nuisance by many sport and commercial fishermen. They are extremely bold compared to other species of pinnipeds, and easily take advantage of man-made structures such as dams and fish ladders that concentrate fish in rivers. They are known to take salmon and rockfish off fishing lines, tear holes in nets, and damage fish in gill nets and fish farm pens. They seem to have little fear of people.

Dolphins and Porpoises

Dolphins and porpoises are two families of odontocetes (toothed whales) that are commonly seen in the Strait of Georgia, but are often confused with one another. Some distinguishing features between the two families include their group sizes, swimming behaviour, shapes of their dorsal fins, the roundness of their heads, the stoutness of their bodies and—should you get close enough—the shapes of their teeth. Dolphins have cone-shaped teeth, and porpoises have flat, spade-shaped teeth.

Four species of odontocetes live in the Strait of Georgia—of which two are delphinids (dolphins) and two are phocoenids (porpoises). The easiest way to distinguish the two families is to look at their dorsal fins and observe their swimming behaviour. Delphinids such as the Pacific white-sided dolphin and killer whale (the world’s largest dolphin) rise higher out of the water when surfacing and have pronounced curved dorsal fins, while the phocoenids such as the harbour porpoise

and Dall's porpoise barely break the surface compared to the dolphins, and have small triangle-shaped dorsal fins. Porpoises also tend to be shyer and more difficult to observe than the bolder dolphins, and are usually found in groups of 2–4 individuals—while the dolphins are in pods of up to 12 individuals that sometimes merge temporarily with others to form superpods of hundreds.

Both families of odontocetes use echolocation to coordinate group movements (repeated clicks) and find food (rapid bursts), but only the dolphins use sonic sounds (clicks, whistles and other vocalizations that humans can hear) to communicate with one another. Porpoises, in contrast, communicate with ultrasonic vocalizations that are well beyond what humans and dolphins can hear, which may allow them to go undetected by killer whales.

Porpoises seem to live a more challenging life than dolphins and die much younger. In fact, they may only live to their mid-teens (possibly 8–15 years) compared with dolphins that may live to 50 years or more.

Dall's porpoises are believed to be the most abundant cetacean in the Strait of Georgia, followed by harbour porpoises, white-sided dolphins and two forms of killer whales—the fish-eating residents and the marine mammal-eating transients. Unfortunately, surveys of porpoise and white-sided dolphin populations have not been undertaken throughout the strait to determine the actual population numbers.

Harbour porpoise (*Phocoena phocoena*)

Harbour porpoises—sometimes referred to as herring hogs, puffing pigs or sea pigs—are the smallest cetacean in the world, with adults reaching 1.5–1.6 m and weighing 45–60 kg. Males are smaller than females at maturity (by about 10 cm and 10 kg).

However, the small size of male harbour porpoises belies the fact that they have long penises—and unusually large testes that account for 4–6 percent of their total body mass (about 13 times larger than the average mammalian species). This means that a 50-kg male has testes that weigh 2–3 kg! Small males with big testes suggest that harbour porpoises are promiscuous and have a reproductive system that is based on sperm competition rather than physical competition between males for female mates.

Mating in this promiscuous and polygynandrous species (both males and females mate with multiple individuals) occurs in summer, and calves are born in spring and summer (when mothers and calves are commonly seen together). However, it is not known how long harbour porpoise calves remain with their mothers once weaned, the degree to which related individuals have long-term relationships, or whether females give birth every year or every second year.

Harbour porpoises have a small triangular-shaped dorsal fin and greyish-white undersides with greyish-brown backs and sides. They break the surface with a slow rolling motion while swimming—showing little more than the rounds of their backs—and rarely approach vessels or show any curiosity about them. They are typically seen in small groups of 2–4 individuals—although ephemeral groups of over 200 animals have been occasionally reported.

Harbour porpoises feed primarily on small schooling fishes in the Strait of Georgia (mostly herring, anchovy, walleye pollock, sand lance, shiner perch, hake and sardines) as well as some sculpins and squid. They feed mostly in near-shore shallow waters (less than 150 m)—but are also known to use deeper waters in the middle of the strait (fig. 1). Hotspots include the south-central strait and many of the mainland inlets north of Campbell River during summer—and in Haro Strait, Howe Sound,



The Marine Mammal Rescue Centre at the Vancouver Aquarium is often called upon to save and care for marine mammals such as this harbour porpoise that stranded on a beach in Horseshoe Bay when only weeks old.

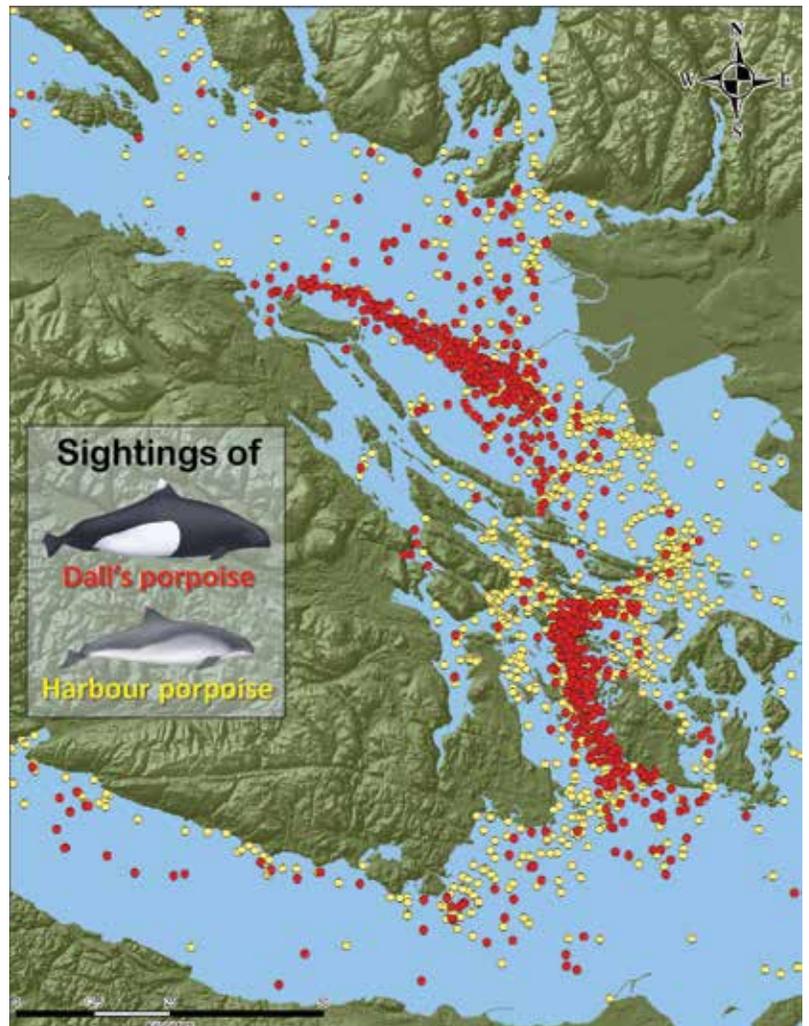
A.W. Trites photo

Figure 1. Sightings of Dall's porpoise (red circles) and harbour porpoise (yellow circles) reported by mariners from 1983 to 2013 show their preferences for different water depths. Data are from the BC Cetacean Sightings Network and are not corrected for effort

Burrard Inlet and the central Strait of Georgia during winter (fig. 1). They may also use the junction of Haro and Juan de Fuca Straits as a breeding site.

Aerial and boat-based surveys of portions of the Salish Sea suggest there are likely fewer than 5,000 harbour porpoises overall. Although the actual size of the harbour porpoise population is unknown, a reduction in frequency of sightings suggests their numbers may be declining. They are the most frequently stranded cetacean in the Strait of Georgia, and are regularly preyed on by transient killer whales and occasionally harassed and drowned by resident killer whales. Harbour porpoises are also believed to be particularly sensitive to human-produced underwater noise and chemical contaminants, and their preference for near-shore habitats may be at odds with shoreline developments. As a result, harbour porpoises in British Columbia are classified as a species of Special Concern under the *Species at Risk Act*.

Genetic analysis has revealed that some of the stranded porpoises in the Strait of Georgia are the progeny of male harbour



porpoises and female Dall's porpoises. These hybrids have the grey skin colorations of the harbour porpoise, but body shapes that are more reminiscent of Dall's porpoise. Field observations further indicate the dive characteristics and behaviours of the hybrids resemble those of the Dall's porpoise. These hybrids are reproductively viable and capable of breeding with either parental species, although the tendency is for them to breed more with Dall's porpoise than the harbour porpoise. The hybrid porpoises were only known to occur in the Strait of Georgia and around southern Vancouver Island until recently when a few hybrids were genetically identified on the outer coasts of British Columbia and Washington State.

Dall's porpoise (*Phocoenoides dalli*)

"Faster than a speeding bullet" is a phrase that may come to mind as Dall's porpoises come racing toward a boat to ride the bow wave. Shaped like a torpedo, Dall's porpoises can swim up to 55 km/h and often zigzag at great speed just below the water surface, creating a spray called a rooster tail (a unique characteristic of this porpoise). These erratic swimmers are the fastest cetacean in British Columbia, and tend to

appear suddenly, and disappear just as fast. Commonly seen one to three at a time—although likely belonging to groups of 2–12 individuals—they are highly active and have occasionally been seen to ride the "snout-wave" of killer whales or other large whales. Dall's porpoises do not bring their bodies much out of the water when travelling fast, but sharply bend their bodies when disappearing underwater during a slow dive, which is distinctive from the roll dive pattern of harbour porpoises.

Coloured like a killer whale (dark-grey to black body with white patches on their flanks and bellies), Dall's porpoises have a short triangular-shaped dorsal fin with white to light grey frosting. Their tail fluke also has a white trailing edge. The distinctive shape, small size and coloration of the dorsal fin should remove any confusion between an adult Dall's porpoise and a baby killer whale. Nevertheless, they seem to be frequently misidentified as baby killer whales.

With thick bodies and small heads—but no beak—Dall's porpoises are the largest of all species of porpoise, growing to 2.2 m with weights of 130–330 kg. They are also sexually dimorphic, meaning males are larger than females. However, unlike the harbour porpoise, the males have small testes and are physically bigger than the females. The males also have secondary sexual characteristics such as a more angled dorsal fin and an enlarged dorsal hump in front of their dorsal fin, and pronounced muscle mass on their tail stocks. All of these characteristics are consistent with a polygynous mating strategy (males mating with multiple females) involving physical competition between males and low rates of copulations. Having a larger body size enables males to physically guard fertile females and ensure the paternity of their next calves.

Dall's porpoises also differ from harbour porpoises by their preference for

Dall's porpoises tend to occur over deep waters and often approach the front of fast-moving vessels where they will weave in and out in groups trying to get the best position to ride the bow-waves.

A.W. Trites photo



deeper waters (fig. 1)—although they share a similar diet of small schooling fishes and squids in the Strait of Georgia. However, Dall’s porpoises eat greater amounts of the deeper-water species (squid, lantern fish, northern smooth tongue, pollock and hake). This reflects their ability to dive to 500 m, and their tendency to exploit the mid- and deep-water zones (fig. 1).

As with the harbour porpoise, life spans are generally thought to be short (about 15–20 years) with few animals believed to be older than 10 years. Births usually occur in the summer (June–September) with gestation lasting 7–11 months, and lactation lasting anywhere from two months to more than a year. As with the harbour porpoise, there is uncertainty about the frequency with which mothers give birth, and it is not yet known whether calves remain with their mothers and whether there are long-term relations between group members. Such uncertainty about much of the basic biology reflects the challenges of studying Dall’s porpoise and the need for more research. No estimates of population size are available, but they are generally considered to be reasonably abundant, though the frequency of sightings in some regions of southern BC has declined over the past 20 years.

Dall’s porpoises are known to associate with Pacific white-sided dolphins, and are preyed upon by transient killer whales. However, their speed and agility likely help to reduce rates of predation.

Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)

Pacific white-sided dolphins—or “lags” as they are commonly called by biologists and others because of their Latin name *Lagenorhynchus*—have been living year-round in the Strait of Georgia since 2005 after an absence of perhaps a hundred years or more. Largely considered an open-ocean species, sporadic sightings of



lags in the nearshore and inshore waters of BC began increasing around southern Vancouver Island in the 1990s. This same nearshore phenomenon was noted further north in BC about a decade earlier. By the early 2000s, there were frequent sightings of Pacific white-sided dolphins in the Strait of Georgia.

Today’s occurrence of dolphins in the inshore waters may reflect an expansion of their range, or a shift in their distribution driven by the availability of food. However, the presence of dolphin bones in First Nation middens, such as on Valdes Island in the Strait of Georgia, indicates that they were here before. What is not yet clear, however, is whether the 100–200 dolphins now residing year-round in the Strait of Georgia are here to stay or whether they will move on.

Their name reflects the large whitish-grey patch that dominates the forward flanks of their bodies and delineates their white bellies from the dark grey of their backs and short snouts. Other distinguishing features of Pacific white-sided dolphins include the dark rings around their eyes, and the greyish trailing edge of their tall dorsal fins. Adults weigh about 75–100 kg and are 2.1–2.2 m long, although females

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can weigh up to 150 kg and males up to 200 kg. Life expectancy may be as old as late forties for females and early forties for males.

Female white-sided dolphins reach maturity at 7–9 years and will have one calf every 4–5 years following a gestation of 11–12 months. Calves are thought to nurse for about 8–10 months, and are sighted most frequently between June and August (the presumed timing of birth).

Pacific white-sided dolphins are believed to form tight-knit groups that vary from 10 to 100, and typically number about 15 individuals. These gregarious groups often split into smaller groups when feeding, and reform into larger aggregations when resting or travelling. They may also be seen mixed among other species such as resident (fish-eating) killer whales, Steller sea lions, humpback whales and Dall's porpoises.

Seasonally, group sizes of Pacific white-sided dolphins are largest during the fall than at any other time of year. In November 2013, an unusually large group was observed near the Gulf Islands and thought by some to have numbered as many as a thousand. These larger groups of dolphins during fall coincide with the return of salmon to the Fraser River and other spawning rivers that flow into the Strait of Georgia. Large groups of dolphins have also been seen close to shore in Vancouver, Squamish and other urban centres during spring, coinciding with schools of spawning herring. Such large dolphin group sizes may provide greater protection from predation—particularly for calves—and have led to dramatic observations of large numbers of dolphins exploding from the water as they flee on mass from the hot pursuit of transient killer whales.

While some Pacific white-sided dolphins are now year-round residents, a greater number are seasonal visitors that feed in the offshore waters of British Columbia during spring and summer, and use the

nearshore waters in fall and winter to feed on salmon and herring. Pacific white-sided dolphins have elevated metabolisms and likely depend on these fatter species of fish to meet their high daily energy needs. Other species consumed include sardines, capelin, hake, pollock, rockfish, sablefish and squid.

White-sided dolphins are known as an energetic and highly acrobatic species. They are also noteworthy for their unabashed approaches to fast-moving boats to bow-ride, and are often seen leaping high out of the water and doing somersaults.

Of the one million Pacific white-sided dolphins throughout the North Pacific Ocean, 25,000 are thought to reside in British Columbia and 100–200 within the Strait of Georgia. However, using these inside waters likely comes at a greater cost because the dolphins are more easily corralled and may be at greater risk of being attacked by transient killer whales.

Resident and transient killer whales (*Orcinus orca*)

Even to the untrained eye, a cetacean with a tall triangular dorsal fin and distinctive black and white coloration is unmistakably a killer whale. But to the trained eye, subtle differences in movements, group sizes, body size, the shape of the dorsal fin, and shape and pigmentation of the saddle patch behind the dorsal fin reveal whether it is a resident (fish-eating) killer whale, a transient (marine mammal-eating) killer whale, or an offshore (possibly shark specialist) killer whale. These three types of killer whales co-exist in British Columbia, but do not associate with one another—and they differ from each other genetically, morphologically and in their vocalizations, social structures and diets.

Only the transient and resident killer whales occur in the Strait of Georgia. As their names imply, resident killer whales are usually found in the same areas year after year—



Transient killer whales (top photo) appear drawn to the Strait of Georgia by the abundant harbour seals, while the southern resident killer whales (bottom photo) feed almost exclusively on Chinook salmon.

A.W. Trites and A.M Hall photos



while the transient killer whales appear to always be on their way to somewhere else. These differences in behaviours of residents and transients ultimately reflect differences in their diets and feeding strategies.

The resident (fish-eating) killer whale is the best-known and studied marine mammal in the Strait of Georgia. Every individual has been photographically recorded, named and placed on a family tree showing lineages and relationships between individuals extending over 50 years. Those

residents that typically come to the Strait of Georgia each summer and fall feed almost exclusively on Chinook salmon, and are believed to winter over the continental shelf between California and northern Vancouver Island. Resident killer whales rely heavily on Chinook salmon from May through September, and consume increasing amounts of chum salmon during fall. Their preference for Chinook is surprising given greater abundances of other species of salmon, and may be due to the larger size,

higher fat content and year-round availability of chinook. Little is known about diets and the whereabouts of the resident killer whales during winter, although they occasionally return to the Salish Sea to feed on a more diverse array of prey that includes smaller chinook and greater numbers of non-salmonids (lingcod, Dover sole and halibut).

There are two resident populations of killer whales in British Columbia—a northern one and a southern one. The northern resident population consists of about 250 whales and has been steadily increasing—but is infrequently seen in the Strait of Georgia, which is at the southern limit of their range. In contrast, the southern resident killer whales are frequently in the Strait of Georgia, but they number significantly fewer (only 80 as of spring 2014). Their numbers have fluctuated since the 1970s (between 67 and 95 individuals between 1974 and 2014), but have shown an overall positive trend (albeit small) since the 1970s when many were captured and sent to aquaria. The southern residents consist of three pods known alphabetically as J, K and L pods, but they do not associate with the northern resident killer whales despite overlaps in their ranges. Compared to northern residents, the southern residents have a smaller population size, a slower growth rate, lower birth rates and higher death rates.

The transient nature of transient killer whales has made it more challenging to get to know them. They used to be seen infrequently in the Strait of Georgia, but are now commonly present, particularly during late summer and early fall when harbour seal pups are weaning. Harbour seals are the preferred prey of transient killer whales, followed by harbour and Dall's porpoises and Steller sea lions. Other species consumed less frequently by transients include Pacific white-sided dolphins, California sea lions, grey whales, minke whales, northern

elephant seals—and the occasional seabird and river otter. Numbers of transient killer whales have been increasing since the 1970s, and total about 250 individuals. This rise in numbers may reflect the concurrent increase in numbers of harbour seals and sea lions, which likely also explains their frequent presence in the Strait of Georgia. The transients that feed on marine mammals within British Columbia range widely from Southeast Alaska to Washington (and possibly California), which means that only a few are likely to be in the Strait of Georgia at any one time.

Killer whales are sexually dimorphic and have notably different sizes of dorsal fins at sexual maturity. Dorsal fins of adult males can be as tall as 2 m—twice the height of a female's dorsal fin. Females may grow as big as 7 m and weigh as much as 7,500 kg, while males may be as long as 9 m and weigh as much as 10,000 kg. Longevity is potentially 50–60 years for males and 80–90 years for females, but average life expectancy is much shorter (about 30 years for males and 50 years for females). Females have only one calf every 4–5 years starting when they are about 15 years old, and may produce as many as 4–5 calves over their reproductive lifetimes. Females will continue leading their pods as they mature and become grandmothers or great-grandmothers, and enter an extended period of reproductive senescence.

Female resident killer whales do not mate with males in their own pods, but appear to be drawn to males that sound the least like them. Avoiding mating with close relatives prevents inbreeding. Calves will learn the dialects of their mothers and related adults, and will pass this on to their offspring with time. Calves also learn the foraging techniques and seasonal locations of their prey.

Unlike most mammals, male and female resident killer whales do not leave their natal groups after weaning. Instead,

sons are destined to stay with their mothers for their entire lives, while daughters may break off to form new pods with their own offspring. However, this matriarchal social-structure does not appear to be the case for transient killer whales.

Transient killer whales typically occur in small groups of 2–5 individuals, while resident pods tend to be much larger. Unlike residents, a transient calf may not stay in its natal matriline for life, and may mix with unrelated individuals as it ages. Social groupings of transient killer whales are thus much more fluid than those of residents.

Transients are stealth hunters that rarely echolocate. They appear to know where concentrations of seals and porpoises are likely to be found, and are presumed to use passive listening to find and catch their prey off-guard. While travelling, transient killer whales typically swim at 6–8 km/h and generally surface three or four times before going down on longer and deeper dives lasting several minutes. However, when hunting prey, these whales can attain short bursts of speeds as high as 45–55 km/h and often make longer dives and erratic movements. Killing often involves rendering seals and porpoises unconscious (by striking them with their tails, or jumping and landing on them with their entire bodies), or holding a large whale underwater with the assistance of others to drown it. Once the prey is subdued, the usually quiet transient killer whales will typically vocalize—sometimes loud enough to be heard above the surface of the water.

In contrast to transient killer whales, resident killer whales are very vocal and share stereotyped calls that are specific to individual pods. They use three types of vocalizations—echolocation clicks (to orient and find prey), whistles (used in social contexts) and pulsed calls (that likely coordinate behaviours and maintain group cohesion). The calls are like dialects and are believed to slowly evolve with time.

They are learned from mothers and related individuals—and will be used for life and passed on to the next generation.

Largely due to small numbers, southern resident killer whales are listed as Endangered, while northern residents and transient killer whales are listed as Threatened with extinction; however, these designations may change in light of increasing transient populations. There is concern that resident killer whales may be having difficulty obtaining enough Chinook salmon to meet their daily needs. There is also concern that underwater noise produced by boats may be interfering with their ability to communicate, detect prey and acquire information about their environment. A third concern is that some individuals have particularly high concentrations of chemical pollutants in their tissues that may suppress the ability of their immune systems to ward off disease. Adult males in particular carry higher levels than reproducing females, which can transfer contaminant to their offspring during lactation, and transients carry much higher levels than residents because they feed higher in the food chain on species with higher concentrations of contaminants.

To date, there is no indication that transient killer whales have been negatively affected by contaminants. Nor do the potential cumulative effects of low chinook abundance and increases in noise pollution and contaminant loads appear to have curtailed the population growth of northern resident killer whales. However, the extent to which these three factors may explain the poor recovery of southern resident numbers is less certain.

Killer whales are iconic species that are intricately tied to the health of salmon and other species of marine mammals. In many ways, killer whales are barometers of ecosystem health and indicators of the well-being of the Strait of Georgia.

Baleen Whales

Whales are divided into two suborders—the odontocetes (toothed whales) and the mysticetes (baleen whales). The baleen whales filter their food by straining water or sediment through a row of baleen sheets that are positioned like the teeth of a comb along their upper jaws. Baleen is made of carotene—just like hair and fingernails—and each sheet of baleen is like a giant badly frayed, hairy-ended fingernail.

Baleen and toothed whales have a small, thin auditory opening on each side of their heads, which are not functional for hearing. Instead, toothed whales receive sounds through a special type of fat called “acoustic fat.” These acoustic fats occur in and around the lower jawbones of toothed whales and extend to the middle and inner ears, which are isolated from the skull to allow for better directional hearing. Hearing in baleen whales is not as well understood as in toothed whales, but may involve using fatty tissues located near the jaw joints to focus sounds to the middle and inner ears.

Another distinguishing difference between the two suborders of cetaceans is their blowhole—odontocetes have only one blowhole, while mysticetes have two and a relative good sense of smell. Baleen whales are also the largest species of whales, and exchange a lot of warm, moist, mucus-filled air each time they blow. The shapes, heights and smells of their steamy plumes differ among species and can help to identify them.

Once heavily targeted for their oil by commercial whaling, which ended in 1967 in British Columbia, baleen whales tend to migrate long distances to winter and give birth in warmer southern waters. Of the baleen species that live in the North Pacific Ocean, three come each year to the Strait of Georgia—minke whales, grey whales and humpback whales. Minke whales are relatively rare despite never having been hunted by whalers, while grey whales and

humpbacks are seen with increasing frequency in the Strait of Georgia—having escaped extinction by whalers.

Grey whale (*Eschrichtius robustus*)

Most grey whales winter in the warm waters that line the west coast of Baja California (Mexico), and summer in the Arctic in the Bering, Chukchi, and Beaufort Seas in Alaska and Russia. Almost the entire population passes each year within a few kilometres of the BC coast. However, a small portion of the population does not complete the long 20,000-km round-trip migration, and summers instead along the North American coast. Of these summer residents, a couple hundred individuals stay and feed in British Columbia.

Most sightings of grey whales in the Strait of Georgia occur in Boundary Bay from March to June. Some of the whales remain here until late November, while others are only here on a side-stop to acquire additional energy before continuing their northward migration. They are also occasionally seen in Haro Strait, and can often be seen from land, passing close to beaches and feeding in shallow waters.

Feeding almost exclusively in summer, grey whales need to store significant amounts of fat to get them through the rest of the year. Many grey whales are therefore in poor body condition when they leave their wintering grounds in Mexico starting in mid-February, and do not have enough energy reserves to get to the food-rich arctic waters. It is thus quite common for thin grey whales to strand during the spring migration.

Calves are conceived in late November and early December during the start of the southbound migration, and will be born 13 months later in late December to early February when the mothers are in Mexico. This long gestation and the high energetic cost of producing milk mean that a female can at best have only one calf every two years.



A few grey whales occasionally stop to feed in Boundary Bay in the spring before continuing their northward migration, and some stay until November before returning to winter in Mexico.

A.W. Trites photos



Calves nurse for 6–8 months and will wean on the summer feeding grounds. Transient killer whales pose a threat to grey whale calves and yearlings during the migration. Mothers will do their best to defend their calves, but do not protect the yearlings. Grey whales mature at about eight years and may live past 70.

Grey whales are named for their mottled grey skin covered with barnacles, barnacle scars and patches of whale lice—which create unique patterns and shades of grey, and helps to photographically identify individuals. They don't have a dorsal fin, but have instead a low hump and a series of 7–15 knobs along their dorsal ridges. They also have 2–7 throat grooves that help enlarge the capacity of their mouth to hold sedi-

ment and water when feeding. Grey whales are the only baleen whales that have an overbite (the upper jaw extends beyond the lower jaw). These upper jaws hold 130–180 short, creamy-white baleen plates (5–40 cm long) that separate the prey from the water and sediment. Adult males average about 13 m and are about a half metre shorter than the females.

Generally quiet, grey whales are known to produce sounds on the breeding and feeding grounds. They tend to be solitary and display little surface behaviour, rarely breaching, but often raising their tails out of the water as they dive. Feeding grey whales follow a predictable pattern of 3–5 bushy-shaped blows before submerging for 3–5 minutes.

Specialized consumers of benthic invertebrates, grey whales tend to feed in soft bottom areas such as muddy bays where they can scoop up mouthfuls of mud or sand to strain out ghost shrimps, small clams and other invertebrates. Feeding involves rolling on their sides to suck sediment into their mouths and straining the invertebrates through their baleen—leaving a pit on the ocean bottom, which can occasionally be seen during low tides. However, most of the summer-resident grey whales in British Columbia have a more varied diet that includes eating mysid shrimps and crab larvae in kelp beds, and herring eggs and larvae in eelgrass. Grey whales are one of the few cetaceans that can be seen from shore because of their preference to feed in shallow bays.

Since the end of whaling, the grey whale population has increased from about 12,000 in 1967 to 27,000 in 1988. However, about one-third of the population disappeared between 1989 and 2002 due to high mortality and reproductive failure associated with reduced food in the Arctic. The population has recovered somewhat since then to between 18,000 and 20,000—of which a few hundred spend their summers in British Columbia. Of these summer residents, only a few use the Strait of Georgia. One of these summer residents caused quite a sensation in 2011 when it swam into False Creek past Science World in downtown Vancouver. The BC popula-

tion of grey whales is considered to be a species of Special Concern.

Minke whale (*Balaenoptera acutorostrata*)

Considered common and one of the most numerous whale species in most of the world's oceans, minke whales are rare on the west coast of North America. There may only be about 450 animals in California, Oregon and Washington waters—and fewer in British Columbia. Minke whales appear to be naturally rare in the eastern North Pacific for unknown reasons, and commercial or First Nations whalers never targeted them. This was likely due to their erratic movements, their shyness and low numbers. Seeing a minke whale in BC is particularly rewarding because of their rarity.

Minke whales are referred to in some places as the lesser rorqual, the lesser finback, or the little piked whale. However, the minke name that has stuck to this little whale can be traced back to a hapless Norwegian whaler named Meincke who continuously misidentified them as blue whales. His repeated error thereafter resulted in others calling these small rorquals—the species of whales with grooves in their throats—Minke's whale.

The smallest baleen whale in the North Pacific, minke whales are about 8 m and 8,000 kg when fully grown (about the size of a killer whale)—with females being about a half metre larger than males. Maximum

Minke whales are beautifully streamlined baleen whales with white bellies, but show relatively little of their bodies between dives other than their dark grey backs and their tall, backward curving dorsal fins.

M.C. Tucker photo



body size is thought to be 10 m and 13,000 kg. Their backs are dark grey and their bellies white, and they have white patches on their pectoral fins—like white arm bands. They reach sexual maturity at about 6–7 years of age, and have a 10-month pregnancy and a 4–5-month lactation period. They may live as long as 50 years.

Minke whales tend to use shallow waters (less than 200 m) in the coastal and inshore areas. They are seen most frequently in the Strait of Georgia in spring and summer, and are assumed to migrate to lower-latitude breeding areas in the fall and winter—although some remain in British Columbia all year. The blows of minke whales are rarely seen, but are clearly recognizable by their distinctive odour—something akin to overcooked rotten broccoli—should anyone be downwind of a minke whale. They are also recognizable by their small size, small backward curving dorsal fin, and generally random surfacing patterns.

Minke whales have a sharply pointed head and a small sickle-shaped dorsal fin located two-thirds of the way along their backs. The shapes of their fins, along with nicks and shading of their fins and flanks, have been used to photographically identify about 30 individuals that have at some time frequented the Salish Sea. Like humpback whales, minke whales have grooved throats that spread open like an accordion when feeding, to accommodate large volumes of water and prey. However, unlike humpback whales, minke whales have small flippers and do not raise their tails out of the water when diving.

Feeding primarily at the surface or just below on small schooling fish (juvenile herring and sand lance) that have been trapped by the whale or by diving seabirds, minke whales are known to also feed on krill and walleye pollock elsewhere in the North Pacific. They generally feed alone, or may associate with flocks of gulls and other seabirds while they lunge and roll at

the surface, or may come vertically upwards through a prey patch with their mouths wide open. They have 230–295 plates of relatively short baleen (about 20 cm long) hanging on each side of their upper jaws to separate their food from the water. Several individuals may feed in an area at one time, or even on the same school of fish.

Much like the challenges of observing harbour porpoises, minke whales show little of their bodies when surfacing and have a tendency to vanish from sight as quickly as they appear. They often take one or two quick breaths and disappear for several minutes. Predicting where they might resurface is nearly impossible because they rarely travel in a straight line. Adults show little if any interest in boats and people, unlike calves, which may hang out with a boat. Overall, minke whales are largely a shy, secretive species that are not very social, and are most often seen alone—though sometimes up to four or five animals can be in the same general area. They make low-frequency calls described as “boings,” which have not been detected in BC waters and may not occur in summer feeding waters.

Groups of 2–13 transient killer whales have been observed chasing and attacking minke whales, but they are one of the fastest rorqual species (if not the fastest) and can usually outswim the transients in open water. Swimming fast is their only defence. There is little they can do should they get cornered in a back bay or get pushed against shore—as happened in 2002 when four transients cornered and killed a minke whale in Ganges Harbour (Salt Spring Island) while about 200 horrified people watched the attack happen metres away from shore. Some people threw rocks at the killer whales in an attempt to save the poor minke.

Numbers of minke whales in BC are believed to be in the low to mid-hundreds, and may number fewer than 25 in the Strait of Georgia.

It is not known whether humpback whales breach to dislodge barnacles and lice from their skin, or if they do it to send a loud underwater signal to other whales, or simply because it is fun.

R. Singh photo



Humpback whale (*Megaptera novaeangliae*)

Historically, about 100–150 humpback whales appear to have occurred each year in the Strait of Georgia, and whale-watching trips departed regularly from Vancouver to see the humpbacks that fed around Bowen Island. Unfortunately, all of that changed in 1907 when the Pacific Whaling Company began operating in Page’s Lagoon (now Piper’s Lagoon) at the north end of Nanaimo.

Pacific Whaling had begun operating two summer whaling stations in 1905 on the west coast of Vancouver Island when they decided to extend their season by whaling the protected waters of the Strait of Georgia during winter. Humpback whales were known to remain in the strait until at least January, and fewer than 100 had been caught here from the late 1860s to 1873 by sailing ships operating from Blubber Bay on Texada Island, Whaletown Bay on Cortes Island, and Whaling Station Bay on Hornby Island. Pacific Whaling proposed to re-establish whaling in the strait using steam-powered ships and exploding harpoon heads.

Captain Cates knew what lay in store for the humpback whales and his fledgling whale-watching business should whaling recommence. He sought to have the whales protected, and reasoned to his Member of Parliament in 1907 that “It is only natural to say that everything that lives should be allowed a certain amount of protection and I might say that by the extermination of these whales from the waters of Howe Sound, it would seriously interfere with our local trade.” Unfortunately, politicians ignored his pleas and the whalers took every whale they could find from 1907–1910. They killed 115 humpback whales within the first year, an unknown number in their second year and the remaining 30 in their third and final year—putting an end to the first whale-watching business in BC. It would be 100 years before the humpbacks would return in numbers to the Strait of Georgia.

Whaling in the strait was just a tiny part of the overall BC whaling industry, which took over 5,700 humpback whales along the BC coast from 1905 to the end of whaling in 1965. By the time whaling ended, only 1,200 humpback whales were thought

to have been left alive in the entire North Pacific Ocean. Although recovery in BC is not yet considered complete, the entire North Pacific humpback whale population now numbers over 21,000 (which exceeds estimates of pre-whaling abundance), and appears to be successfully reclaiming former feeding and breeding grounds.

Humpback whales breed in Mexico, Hawaii and southern Asia during winter, and feed along the Pacific Rim from California to Russia in summer. Those that feed from central Vancouver Island through Southeast Alaska (about 3,000–5,000 whales) tend to breed and winter in Hawaii, while the smaller numbers that feed around southwestern Vancouver Island and Washington State (about 200–400 whales) tend to winter off Mexico, as well as Hawaii. Most of these whales are in BC during summer, although a small number remain throughout the year. The number of humpback whales relying on prey in BC during summer is about 2,500 individuals.

One of the easier species to identify, humpback whales lack a dorsal fin, but have a small distinct hump two-thirds of the way along their backs that is particularly pronounced when they dive—hence their name, humpbacked whale. They also have 14–22 throat grooves and unusually long pectoral fins (about a quarter to a third of their body lengths), and large bumps or knobs called tubercles on their heads along the upper and lower jaws and the leading edge of their flippers. These bumps are remnant hair follicles. The trailing edges on their tails have particularly distinctive shapes and distinct black and white patterns under their tails that are used by biologists to photographically identify individuals.

A newborn calf weighs a hefty 900–1,500 kg and is about 4.5 m long. This is about one-third the body length of their mothers. Females grow to about 14 m—about 1 m longer than males—and weigh about 34,000 kg. Calves are born in Mexico

or Hawaii between December and April, and are usually weaned within a year—although some may stay a second year with their mothers. Mothers rely on stored body fat to produce milk during the first few months after birth and during the migration northward to the feeding grounds. They feed heavily from May to December to replace their lost body mass, store extra fat for the upcoming winter, and continue producing milk for their calves. Such rigours of raising calves likely explain why females tend to only have one calf every two to three years.

Courting and mating occur from December to May—overlapping the timing of births. During this period, the males will attract females and potentially ward off other males by singing complex songs that evolve from year to year, and are specific to breeding areas. Pregnancy lasts 11 months. Humpback whales become sexually mature at 5–7 years of age, and may live to be over 50 years old.

All humpback whales (except calves) fast during migration and while on the breeding grounds. Once back in British Columbia or one of their other traditional feeding areas, humpback whales will feed heavily on krill, copepods and small schooling fish such as herring, capelin, sand lance, juvenile salmon, sardines (pilchard), cod and mackerel. Krill (euphasids) appear to be their primary prey in British Columbia, but herring, sand lance and sardines are also important.

Tending to be solitary, but often feeding cooperatively in groups, humpback whales use different techniques to capture their prey, including lunging for patches concentrated on the surface, or corralling fish with their large pectoral fins, or creating a circular wall of small bubbles to contain the fish before lunging upwards through it with mouths wide open (known as bubble-net feeding). The force of the water entering the mouth expands the throat

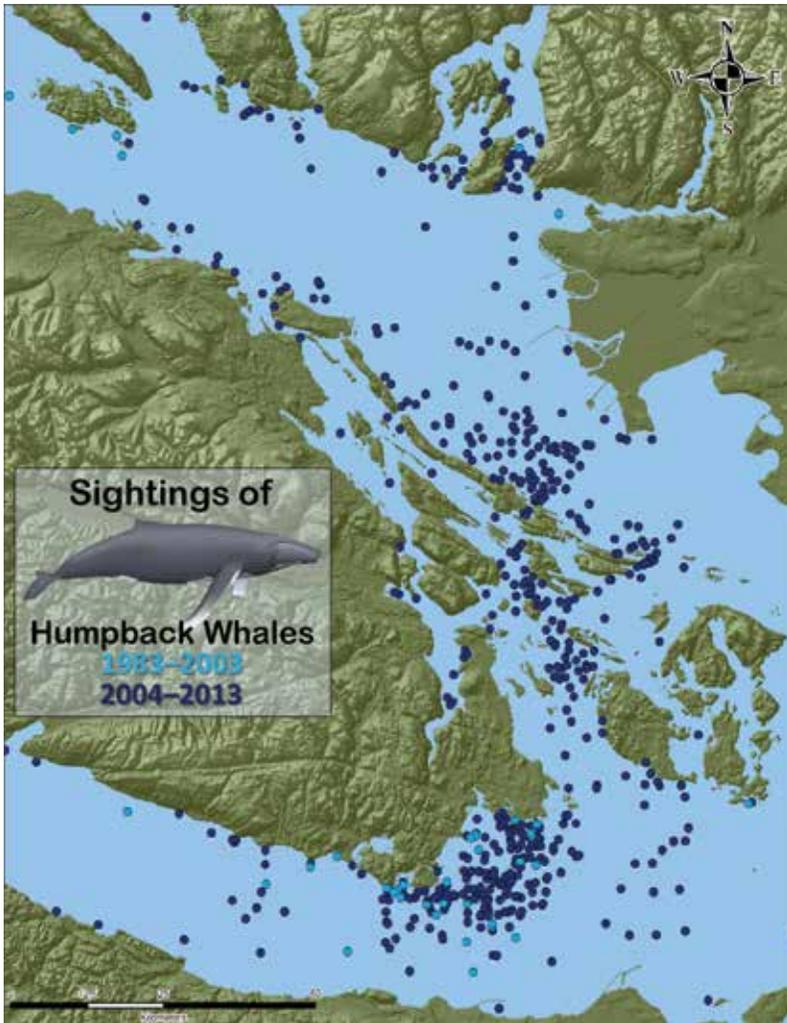


Figure 2. Locations of humpback whales reported by mariners showing a significant increase in sightings from 1983 to 2003 (turquoise circles) to 2004-2013 (dark blue circles).

Data are from the BC Cetacean Sightings Network (Vancouver Aquarium and Fisheries and Oceans Canada) and are not corrected for effort

grooves that extend from the lower jaws to the abdomen, and allows the whale to hold an enormous amount of water and food in its mouth at one time. Water is expelled through the baleen as the mouth is closed and the throat grooves contract. A process of cross-filtration is believed to explain why humpback whales and other baleen whales do not plug their baleen with food. This is the same filtration process used to produce clear fruit juices whereby most of the hard parts pass across the surface of the filter, rather than into it.

Humpback whales are a major draw for commercial and recreational whale watchers because they occur near shore, are often curious about boats, are easily approached and they often put on a great show by

breaching, raising their large tails when diving deep, or slapping the surface with their gigantic pectoral fins. Although listed as a species of Special Concern, they have made a remarkable recovery and appear to be reclaiming the Strait of Georgia after a 100-year absence. Humpbacks are now reported regularly near Powell River and Nanaimo, and record numbers entered the Strait in 2013 (fig. 2). Captain Cates would be pleased to know that the humpback whales that led him to start his fledgling whale-watching business over 100 years ago are back!

Threats and Conservation

Protection from culling and hunting has allowed marine mammals to increase and repopulate the Strait of Georgia. However, the Strait of Georgia has changed significantly over the past hundred years, and is likely to change even more in the next hundred years. Only time will tell the extent to which marine mammals will adapt and prosper, or whether they may choose to be somewhere else.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has a subcommittee called the Marine Mammal Specialist Committee that meets every year to review the status of marine mammals in Canada. Comprehensive, authoritative reports are prepared for those species that are or may be at risk. The detailed reports compile all existing information, and identify the threats that need to be addressed to ensure that species are removed from the list.

One of the most serious concerns facing whales, dolphins and porpoises in the Strait of Georgia is underwater noise associated with vessel traffic. Most engine noises are muffled in the water to protect human ears, but the sound is deafening to species that hear underwater. Marine mammals such as killer whales and dolphins that depend on sound may have their hearing damaged

and be unable to communicate with one another or locate prey efficiently.

Vessels may also strike and kill marine mammals, and could cause a major disaster if they were ever to spill significant amounts of oil. The Strait of Georgia and Haro Strait are extremely busy waterways that are likely to only become busier with time.

Some marine mammals, particularly seals and sea lions, have frequent interactions with fisheries and are known to remove fish from nets and fishing lines. This occasionally results in a sea lion getting a hook lodged in its stomach with a fishing line and a large silver flasher dangling from its mouth. Others may end up with a rope, netting or a plastic packing band around their necks. These rings-around-the-collar and stomach piercings typically lead to slow deaths unless removed. In addition, a few harbour porpoises and small seals sometimes entangle and drown in gill nets, and the occasional humpback whales may end up with fish netting or ropes and buoys from crab pots tightly wound around their tails or flippers. However, such incidents of entanglement are relatively rare and not believed to pose population-level threats.

A bigger potential concern for marine mammals is the transfer of terrestrial pathogens to the marine environment. Waste from pets, farm animals and humans ultimately ends up flowing through pipes directly or indirectly into the ocean. This waste may contain antibiotics, pathogens and parasites that marine mammals are ill equipped to deal with. Kitty litter, for example, is often flushed down toilets without a second thought. However, cats shed parasites in the litter, which have killed sea otters in California and could have a similar effect on other marine mammals in the Strait of Georgia. Massive die-offs could occur from parasites or diseases introduced into the ocean, which marine mammals have not previously encountered and developed resistance against. There is also

an increasing awareness that micro-plastics are now in the food web and may also pose health risks.

Contaminants are another threat that flow all too readily into the Strait of Georgia. Fortunately, PCBs, DDT, dioxins and furans have been decreasing since actions were taken to regulate and control their use and production, but newer contaminants such as fire-retardant chemicals are being developed and used that pose new and previously unrecognized harm to marine mammals. These chemicals typically enter the bottom of the food chain and get concentrated as they are passed up the food pyramid. Marine mammals sit at the top of this pyramid, and may experience reproductive failure and be more susceptible to disease and parasites when carrying heavy contaminant loads.

Another potential looming threat is climate change, which is predicted to change sea temperatures and the water level of the Strait of Georgia. An increase in water temperature is unlikely to have any physiological effect on the marine mammals in the strait (given the range of water temperatures many of them already experience during annual migrations), but is likely to have an indirect effect by altering the abundance and distribution of the fish and invertebrates they feed on. Changes in water depth may similarly have an effect on some prey species in shallow areas, and will likely change the availability of haulout sites used by seals and sea lions. However, the true effect of climate change on marine mammals and those that live around the Strait of Georgia remains to be seen.

As important as it is to mitigate the threats faced by marine mammals in local waters, it is also important to recognize that many of the individuals that come to the strait each year may face greater threats when out of sight and mind. The Strait of Georgia is a cog in the much greater interconnected marine ecosystem. Many of the

species that use the Strait of Georgia travel considerable distances to other feeding and breeding areas, and may encounter greater threats in these other areas.

In addition to recognizing and minimizing threats that may limit marine mammals, it is equally important to recognize that marine mammals may pose a threat to other species in the strait because of their high metabolic rates, their large body size and large numbers—and they may be having a particularly negative effect on the survival of salmon and rockfish. Marine mammals are also known to damage fish and fishing gear, and have readily learned how to remove fish from sport fishing lines. Habituation with humans may also mean that they ultimately start using other areas frequented by people, such as docks and beaches.

Conclusions

Many eyes and ears keep watch over marine mammals in the Strait of Georgia. They range from the dedicated individuals who mobilize to help a stranded cetacean or care for a sick seal or porpoise, to the mariners and whale watchers who are often the

first to notice unusual events or the changes in numbers and distribution. For them and many others, marine mammals are fascinating creatures and important indicators of the health of the Strait of Georgia.

Rapid changes in numbers and distribution of marine mammals in the strait since the 1980s have led some people to question whether the ecosystem is out of balance. For them, the reference point for normality was a time and place that was largely devoid of marine mammals following their intentional removals. For others, there is recognition that the ecosystem is balancing itself as it returns to its more natural state.

The eleven species of seals, sea lions, porpoises, dolphins and baleen whales that inhabit the Strait of Georgia constitute an incredible diversity of abundant marine life to be living on the doorstep of one of the largest concentrations of people in North America. It represents one of the most accessible assemblages of marine mammals in the world for people to see and observe, and is a testament to the richness and biodiversity of the Strait of Georgia that often goes unseen and unrecognized by many who walk its shores.

Mother-pup pairs of harbour seals can commonly be seen in summer separated from other pairs of mothers and pups.

A.W. Trites photo

