Physeter macrocephalus (Sperm Whale)

Family: Physeteridae (Sperm Whales)
Order: Cetacea (Whales and Dolphins)
Class: Mammalia (Mammals)

Fig. 1. Sperm whale, *Physeter microcephalus.*

[http://uk.whales.org/species-guide/sperm-whale, downloaded 21 October 2015]

TRAITS. The sperm whale *Physeter macrocephalus*, formerly known as *P. catodon*, is the largest of the toothed whales (odontocetes) (Acsonline.org, 2015). Their lower jaws are long, narrow and contain 40-52 conical teeth (Fig. 2), each of which can grow to a length of 20 cm and weigh up to 1 kg (WDC, Whale and Dolphin Conservation, 2015). This species shows the greatest sexual dimorphism of all cetaceans; females reach lengths of 11 m whereas males reach lengths of 15 m or more (Whitehead, 2003: p8). The skin of a sperm whale has a wrinkly appearance and ranges from dark grey to brownish-grey in colour on the head and back with white colouring around the mouth and on the stomach (Acsonline.org, 2015). The short rounded dorsal fin (Fig. 3) is followed by a series of bumps or knuckles along its back. Its blow hole is located to the front and left of the head, has a distinctive S-shape and is asymmetrical (Whitehead, 2003). Most notably, the head accounts for one third of the body and contains the spermaceti organ (WDC, Whale and Dolphin Conservation, 2015). This organ, unique to sperm whales, has a general barrel shape, occupying a quarter to a third of the body and is the most powerful natural sonar system (Whitehead, 2003).

ECOLOGY. Sperm whales inhabit all the oceans and seas of the world except near the poles, and the Red and the Black Seas (Whitehead, 2003). Females and calves remain in warmer surface waters in the tropics and subtropics (Curé et al., 2013) where surface water temperatures are above 15°C (Whitehead, 2003). Males have a more diverse distribution as they are found at higher latitudes and in colder waters (Curé et al. 2013) which may border pack ice and be close to 0°C in

temperature (Whitehead, 2003). Both sexes generally spend the majority of their time in deep water. These whales can also be found in various specific areas in high densities, known as "grounds" (Whitehead, 2003: p36), as a result of the high primary (plant) and secondary (animal) productivity there (Weilgart and Whitehead, 1997).

SOCIAL ORGANIZATION. Social structure in sperm whales exhibits sexual segregation (Gero et al., 2009). Females and young live in generally stable units of 10-12 individuals, usually associated with a specific matriarchal lineage (Weilgart and Whitehead, 1997). Units serve several social functions such as communal caring for young, with many individuals baby-sitting and suckling a single calf; communal defence against predators; and socialization by rubbing against each other (Weilgart and Whitehead, 1997; Gero et al., 2009, 2013; Whitehead et al., 2012). Multiple units may merge for a few hours up to a few days to form groups, which can range in size from 5-30 individuals (Whitehead et al., 2012). Females and young form two main types of associations: "constant companions" which occur with members of their stable unit and "casual acquaintances" which occur between members of transiently associating units (Christal et al., 1998). Evidence also suggests that stable units may split up (Christal et al., 1998) and that there may be transfers of individuals between units (Whitehead et al., 2012). Males become more solitary as they age, they leave the unit around the age of 10 years or when a new calf is born, as this triggers a dissipation in the social interactions between the mother and her previous male calf (Whitehead e al., 2012: Gero et al., 2013). They may form loosely associated bachelor groups but then go on to live alone (Whitehead et al., 2012).

ACTIVITY. Sperm whales spend long periods of time diving to forage for food in the deep. A sperm whale spends approximately 72% of its life deep diving (Watwood et al., 2006). In an average dive cycle a sperm whale can cover 3 km horizontally and a vertical distance of 0.5 km (Whitehead, 2003: p78). Their speeds during the ascending and descending periods of the dive can range between 30-100 m/min (Whitehead, 2003: p79). They often have recovery periods between 7-10 minutes at the surface between dives (Whitehead, 2003: p79). They also perform resting dives in one of two positions, head-up or head-down; studies suggest that they use these drifting dives to sleep (Miller et al., 2008). Other activities include fluking-up, raising their fluke before a dive; side-fluking which involves waving their flukes horizontally at the surface while they are vertical and spyhopping which occurs when they raise their heads out of the water (Arnbom et al., 1987). They travel at an average speed of 3.5-6 km/hour but the maximum sustainable speed is 18-22 km/hour (Whitehead et al., 2003).

FORAGING BEHAVIOUR. Sperm whales feed in deep waters, mainly on squid and in some cases fish, which they forage for by diving (Mathias et al., 2012). They dive, on average, to depths of 400-1200 m (Watwood et al., 2006) but have been known to reach depths of 3000 m (Clarke, 1976). These dive cycles can last between 30-50 minutes with an average time of 45 minutes (Watwood et al., 2006). They use sonar (echolocation clicks) to hunt and locate prey (Madsen et al., 2007). These clicks have very far reaching detection ranges due to the nature of their production from the specialized spermaceti organ (Madsen et al., 2007) and are modified to detect medium-sized squids (Gannier et al., 2012). They spend only half of the dive cycle actively foraging and hunting prey, the other half is spent descending and ascending from and to the surface (Watwood et al., 2006). As a result of their hunting efficiency and wide distribution, their impact on the ecology of the ocean is significant, as they play active roles in nutrient cycling (Watwood et al.,

2006). They have also been found to exhibit depredation behaviour, meaning that they remove fish from fishing gear, especially in northern waters (Mathias et al., 2012). This behaviour manifests in two ways, deep and shallow depredation; deep depredation mirrors deep foraging dives with a few differences in the rates of communicative sounds produced (Mathias et al., 2012). Shallow depredation shows no similar behaviours to natural foraging as it involves shallower dives, irregular dive cycle lengths and much more intense acoustic communication and activity (Mathias et al., 2012).

COMMUNICATION. Sperm whales use various acoustic elements in their communication with one another including clicks, creaks and codas. A click is an impulsive sound generated by the spermaceti organ usually during dives (Mathias et al., 2012). A creak is defined as a series of pulses produced at a rate of 10/s or higher, these usually occur at foraging depths and give an indication that the animal has changed its direction (Mathias et al., 2012). A coda is a set or patterned sequence of clicks and is usually exchanged between socializing whales that are in close proximity at the surface (Weilgart and Whitehead, 2007). The main function of codas is in upholding social cohesion between groups. Each group can develop a repertoire of codas which differs from that of groups in other geographical locations; this is possible because codas are learnt by juveniles from the members of their unit and so distinct characteristics are preserved. This ability to develop codas unique to a specific set of groups makes sperm whales the only other cetaceans, aside from orcas (killer whales), that possess dialects (Weilgart and Whitehead, 2007).

SEXUAL BEHAVIOUR. Males become sexually mature during their teenage years (Whitehead, 2003) and once in their late twenty's they return to the habitats of the females periodically to breed (Whitehead et al., 2012). Once sexually mature, females give birth to one calf every 4-6 years over two decades with this rate decreasing over the succeeding decades (Whitehead, 2003). During breeding, males travel between units and remain with any given unit for a few hours at most (Gero et al., 2009: Weilgart and Whitehead, 2007). No parental care is given by males; they do not form monogamous relationships (Whitehead, 2003).

JUVENILE BEHAVIOUR. After a 15 month gestation period sperm whales are born, they suckle until roughly 2 years old and females become sexually mature around 9 years old (Whitehead, 2003). Males reach sexual maturity in their teens (Whitehead, 2003). Calves are jostled about by the mother as well as several other adults soon after birth (Whitehead, 2003). Juveniles neither fluke (Gero et al., 2015) nor are they capable of performing deep foraging dives (Gero et al., 2009). Instead they perform shallow dives under the peduncle (that area of the whale from the dorsal fin to the tail) of their mother (Fig. 4) which are associated with suckling (Gero et al., 2009). The calf mainly engages in breathing, swimming and suckling for the first few days of its life (Whitehead, 2003). Its ability to swim well a few days after birth is essential as it may need to escape predators and keep up with the rest of the unit (Whitehead, 2003). Females remain with the unit but males eventually leave, before they are sexually mature (Christal et al., 1998).

ANTIPREDATOR BEHAVIOUR. These whales have two main predators, sharks and orcas (Curé et al. 2013). Common among all responses to predators is a cessation of foraging dives, silence among the unit and a tight clustering at the surface before an attack (Whitehead, 2003). If present, the young are placed in the centre and the females form a tight circle with individuals less than 3 m apart and their tails pointing outwards (Arnbom et al., 1987). Alternatively they may turn

to face their predators while in a ranked formation, presenting their heads to the attackers and swimming towards them with the calves in the middle to prevent an attack on their flank. During attacks they also fluke-up, spyhop and sidefluke (Arnbom et al., 1987). Males which are normally solitary, respond socially when threatened by clustering or production of social sounds, they also stop diving and immediately return to the surface (Curé et al., 2013).

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Fig. 2. Lower jaw of *Physeter microcephalus.*

[Physeter macrocephalus\sperm whale lower jaw.jpg downloaded 27 October 2015]

Fig. 3. Dorsal fin and knuckles along the back of a sperm whale.

[Physeter macrocephalus\pserm whale dorsal fin.jpg downloaded 27 October 2015]

Fig. 4. Baby sperm whale suckling from its mother, which rolls over to allow access to the mammary slits.

[http://www.wayneosborn.com.au/new-life.html downloaded 4 November 2015]