Comparison between zalophus californianus and tursiops truncates

Environment, Animals

Introduction

Zalophus californianus, more commonly known as the California Sea Lions, and Tursiops truncates, or the common Bottlenose Dolphins are marine mammals that share various characteristics with one another.

Zalophus Californianus

Zalophus californianus are one of the six species of sea lions that can be found in southeast Alaska, central Mexico, and the Gulf of California. This type of sea lion is best known for its intelligence and playfulness. They are very social in land and water, except during their breeding season where both the female and male exhibit aggressive characteristics for protection purposes. This type of organism is found in colonies due to their social characteristic. In terms of its physical characteristics, the males are larger than the females where they can grow up to 390 kilograms and 110 kilograms respectively and they range in color from a dark brown to a lighter, golden brown.

They are known to have a " dog-like" face, ear flaps, and large flippers that allow them to walk on land making it one of the few marine mammals that can simultaneously inhabit the sea and land. Their diet consists of mainly squid, anchovies, mackerel, rockfish, and sardines. Most of the sea lions that are used in zoos and aquariums are the California Sea Lions because of their ability to be trained and learn tricks effectively.

Tursiops Truncates

Tursiops truncates are one of the three species of the Genus Tursiops that inhabit temperate and tropical waters of the Atlantic and Pacific Ocean and are found in offshore and coastal waters of the US Gulf of Mexico (Vollmer and Rosel, 2017). Tursiops truncates are known as the common Bottlenose Dolphin because they are the type of dolphin to mainly be held in captivity in zoos and aquariums, just like the California Sea Lion. This type of dolphin travels in packs and is extremely playful and social, except for the breeding season where the males become overprotective of the female they choose, similar to the California Sea Lion.

Tursiops truncates exhibit a keen sense of intellect where they demonstrate it in their ability to solve problems in experimental trials and portray their cognitive skills through their speed and agility allowing them to acquire certain behaviors. Bottlenose Dolphins lack many of the external characteristics that terrestrial animals have where they have a fusiform body consisting of front flippers, flukes, and a dorsal fin. They range in size from 244-381 cm long and weigh about 500 kg in adult males while the adult females are typically between 228- 366 cm and weigh about 250 kg. Their diet consists of mainly squid and pelagic fish.

Uni-Hemispheric and Asymmetrical Sleep

Moreover, Tursiops truncates and Zalophus californianus share a unique characteristic that not even Homo sapiens have, that being uni-hemispheric and asymmetrical sleep. The more common form of sleep involves the whole brain known as bi-hemispheric sleep where both cerebral hemispheres are inactive while the organism sleeps. However, in uni-hemispheric sleep one of the cerebral hemispheres remains functioning while the other hemisphere is inactive or “ sleeping.” Initially, it was believed that uni-hemispheric sleep would be disadvantageous since it would mean a reduction of time sleeping and the associated recovery process would be longer (Mascetti, 2016).

However, the behavior and health of aquatic animals that portray uni-hemispheric sleep does not seem to be affected. Very little information has been discovered on the neural mechanisms involved in this type of sleeping mechanism, but it is suggested that some of the brain structures involved are the brain stem, hypothalamus and the basal forebrain. Interestingly, cetaceans like the Tursiops truncates can alternate between bi-hemispheric and uni-hemispheric sleep along with rapid eye movement (REM) sleep events (Mascetti, 2016). However, seals like the Zalophus californianus only exhibit uni-hemispheric sleep and suppress REM sleep for long periods of time (Lyamin et al., 2018).

Mostly all land mammals alternate between slow-wave sleep (SWS) and REM sleep. REM sleep is necessary to maintain homeostasis in the body. Thus, deprivation of REM sleep would result in longer periods of recovery REM sleep afterward and it can be extremely dangerous causing possible physiological dysfunction and the extreme of death. However, Zalophus californianus are able to suppress REM for periods of days and weeks or eliminate it altogether. It would be expected for the recovery periods for REM sleep would be longer, but it has been shown that Zalophus californianus display minimal or almost no REM rebound (Lyamin et al., 2018).

Locomotion

Furthermore, in terms of their locomotion, the Zalophus californianus are distinct from the Tursiops truncates since California Sea Lions are both aquatic and terrestrial mammals rather than the common Bottlenose Dolphin that is simply an aquatic mammal. Allegedly, it is believed that Californian Sea Lions developed the framework for their locomotion from fissiped carnivores. However, this type of sea lions has undergone adaptation allowing them to have the mode of locomotion that they do. The distinction between the fissiped carnivores and the Zalophus californianus is the fact that the sea lions use their forelimbs. Fissipeds carry out pure limb retraction rather than California Sea Lions who execute propulsive thrusts with their large flippers through medial rotation, adduction, and retraction of the forelimbs (English, 1976).

Unlike fissipeds, the Zalophus californianus does not use hindlimb movements allowing them to swim using their hind flippers to propel through the water and their tail for steering while rotating their hind flippers to “ walk” on land. In contrast to California Sea Lions, the common Bottlenose Dolphin is an aquatic mammal whose vertebral column allows is to generate the dorsoventral bending characteristic of this cetacean. Studies have been conducted finding results that the Tursiops truncates has a vertebral column that is able to store elastic energy and dampen oscillations while allowing it to control the body’s locomotor reconfigurations (J H Long et al., 1997). Their skeletal structure plays a vital role in the dolphin’s incredible power allowing them to swim at great speeds of up to 18. 6 mph.

Their power is dependent on the vertical oscillations of the tail and flukes while the caudal fin allows it surpass turbulence and for them to glide past the water. Interestingly, the muscles of the Tursiops truncates generate seven times as much energy as any other type of mammalian muscles (J H Long et al., 1997); gliding help the common Bottlenose Dolphin conserve less energy so not only do they generate more energy, but also conserve more energy providing a great advantage. The flukes help the dolphin move forwards, the dorsal fin maintains thermoregulation, and the pectorals help them turn and stop. X-rays display similar bone structure of the pectorals to that of the bone structure found in the wrists and hand of human. Overall, the skeletal structure of the Tursiops truncates and the Zalophus californianus contributes to their ability to glide swiftly in the water while allowing the other to alternate between swimming and walking on land.

Communication

Both being incredibly intelligent animals, the Tursiops truncates and Zalophus californianus have unique forms of communication. The common Bottlenose Dolphin has an extensive and complex form of communication including echolocation. Echolocation is the ability to locate objects based on sound. Very few organisms share this ability, like bats, and dolphins are one of them (Thomas et al., 2004). This is a trait that they have adapted as a result of their poor eyesight. During their echolocation, the Tursiops truncates emits certain clicks and whistles that allows them to maintain vigilance in the ocean and locate prey along with other dolphins (Harder, 2016). These whistles and clicks allow them to emit signal when they are in distress and to communicate amongst each other.

Not only do they whistle and clicks, they have the mental capacity of imitating other sounds as it is seen in many entertainment-shows in zoos and aquariums. As mentioned earlier, dolphins perform uni-hemispheric sleep where one hemisphere of the brain remains dormant while it sleeps while the other one is active. It is hypothesized that the reason for which dolphins have the ability to perform echolocation is derived from uni-hemispheric sleep. Not only does echolocation help them communicate, but through the high-intensity clicks the dolphins conserve oxygen (Noren et al., 2017). A study consisting of 15 days, three sessions of five days each, showed that dolphins can successfully detect and report targets while maintaining echolocation behaviors showing no significant decrement in performance over the progression of the sessions. In other words, the study showed results that through echolocation, dolphins can monitor their environment and remain vigilant (Branstetter et al., 2012).

Similarly, California Sea Lions are extremely vocal animals that perform sounds above and below water. However, their vocalization is not as complex as that of dolphins since they do not have the ability to perform echolocation. Instead, they produce sounds like barks, growls, and grunts to communicate with one another and as signals for stressful moments. However, the majority of the time, the purpose for emitting these noises is to maintain or claim territory. Some suggest that the sounds emitted by the Zalophus californianus, or sea lions in general, mimic the sounds produced by a trumpet and honking or even roaring. Unlike dolphins, they have a well-developed eyesight that allows them to navigate the low-light areas of the ocean for long periods of time.

Even though they form large groups, all emitting sounds at the same time, pups are able to recognize the calls made by their mothers instinctively and the pup responds back to its mother with a unique " bleat" that she recognizes (Meyer, 2017). Due to the large array of sounds they produce California Sea Lions are deemed as one of the noisiest pinniped species.

Conclusion

Overall, the Zalophus californianus and the Tursiops truncates are two marine mammals that are composed of many unique traits that sets each as their own species while uniting them in some. The most interesting and main feature that unifies California Sea Lions and the Common Bottlenose Dolphin is uni-hemispheric sleep without needing any or long REM recovery periods setting them completely on the opposite realm of humans and many other species that perform bi-hemispheric sleep.

Also, their form of locomotion and communication, although its sharply different, is very distinguishing allowing each organism to perform the way it does. All things considered, both of these organisms are ones which still contain many hidden features that make them so distinct in the marine mammals' phylogeny.

Annotated Bibliography

1. Branstetter, B. K., Finneran, J. J., Fletcher, E. A., Weisman, B. C., & Ridgway, S. H. (2012). Dolphins Can Maintain Vigilant Behavior through Echolocation for 15 Days without Interruption or Cognitive Impairment. PLoS ONE, 7(10), 1–10. http://eds. a. ebscohost. com. ezproxy. fiu. edu/eds/detail/detail? vid= 0&sid= 8b6bf76c-b876-4683-aa42-9a1dfbc5d62c%40sdc-v-sessmgr04&bdata= JnNpdGU9ZWRzLWxpdmU%3d#AN= 83523656&db= a9h The authors of this source provide useful information in describing the advantages that echolocation poses to dolphins. They do not merely state the facts, but conduct a study providing statistical data that demonstrates that, through echolocation, dolphins can remain attentive without it leading to a cognitive or physiological dysfunction. This source was helpful for the paper in providing the main form of communication in dolphins along with supporting its derivation from their ability to perform uni-hemispheric sleep.
2. English, Arthur W. (1976) Limb movements and locomotor function in the California sea lion (Zalophus californianus). Journal of Zoology, 178(3), 341-364. https://doi. org/10. 1111/j. 1469-7998. 1976. tb02274. x The source provides useful information in explain the skeletal structure and morphology of California Sea Lions by providing from which organism it was derived from allowing it to be a marine and land mammal. It is a reliable source since it is a journal that has been peer-reviewed. The source is relevant for the literature review in providing evidence that helps describe the locomotion of California Sea Lions in

comparison to the Common Bottlenose Dolphin that is only a marine animal.

3. Harder, J. H., Hill, H. M., Dudzinski, K. M., Sanabria, K. T., Guarino, S., & Kuczaj, I. S. A. (2016). The Development of Echolocation in Bottlenose Dolphins, (1). Retrieved from http://http://search. ebscohost. com/login. aspx? direct= true&db= edssch&AN= edssch. qt0q22949q&site= eds-live The authors of this source did a great job in explaining the mechanisms of echolocation and how it was developed in the Common Bottlenose Dolphin providing it great adaptations. In terms of its relevancy for this paper, it was used to provide more information on the purposes of echolocation in dolphins to compare it to how the California Sea Lions lack this form of communication where theirs is much simpler.
4. J H Long, Jr, D A Pabst, W R Shepherd, W A McLellan. (1997) Journal of Experimental Biology. Locomotor design of dolphin vertebral columns: bending mechanics and morphology of Delphinus delphis 200, 65-81. http://jeb. biologists. org/content/200/1/65. short The authors of this source go in depth on the specific body parts of the dolphin that are involved in its locomotion allowing it to maneuver the way that it does. It also provides statistical data that provides evidence on the functioning of the vertebral column in dolphins. This source was useful in using it to provide evidence on the locomotion of the Common Bottlenose Dolphin in comparison to that of the California Sea Lions.
5. Lyamin, O. I., Kosenko, P. O., Korneva, S. M., Vyssotski, A. L., Mukhametov, L. M., & Siegel, J. M. (2018). Fur Seals Suppress REM

Sleep for Very Long Periods without Subsequent Rebound. Current Biology, (12). https://www. cell. com/current-biology/fulltext/S0960-9822(18)30624-9? _returnURL= https%3A%2F%2Flinkinghub. elsevier. com%2Fretrieve%2Fpii%2FS0960982218306249%3Fshowall%3Dtrue This source does an efficient job on introducing the concept of uni-hemispheric sleep while explaining the disparity between REM and SWS sleep. In specific, it mentions the ability of Sea Lions to be able to perform uni-hemispheric sleep and the advantages that this trait provides for it. This source was incorporated in the literature review to describe the uniqueness of California Sea Lions in being able to perform uni-hemispheric sleep without requiring none or little period of REM sleep recovery periods.

6. Mascetti GG. (2016). Unihemispheric sleep and asymmetrical sleep: behavioral, neurophysiological, and functional perspectives. Nature and Science of Sleep, Vol 2016, Iss Issue 1, Pp 221-238 (2016), (Issue 1), 221. Retrieved from https://doaj. org/article/3b9133580hy0d945dd9cea5ddbee407286 The author of this source provides background information on both bi-hemispheric and uni-hemispheric sleeping explaining their differences and the types of organisms that do each. This source is relevant for the paper in providing the basics for uni-hemispheric sleep in order to describe its benefits in the organisms being compared in the literature review. The source is incorporated in the paper in the section that describes that the California Sea Lions and the Common Bottlenose Dolphin are

unified by this distinct trait that is deemed rare and its functioning cannot be explained fully.

7. Meyer, M. S., Rickert, S. S., Pearce, H. L., Khan, O. A., van Bonn, W., Johnson, S. P., & Lahvis, G. P. (2017). Social Interactions of Stranded and Recovering Immature California Sea Lions (Zalophus californianus). Aquatic Mammals, (5), 517. https://doi. org/10. 1578/AM. 43. 5. 2017. 517 The authors of this source provide useful information in describing how California Sea Lion interact amongst one another. They do not merely state the facts but provide statistical data that demonstrates how stranded California Sea Lions suffer in finding prey compared to those found in colonies. This source was helpful for the paper in providing the main form of communication in California Sea Lions and how it differentiates from how the Common Bottlenose Dolphin communicates.
8. Noren, D. P., Holt, M. M., Dunkin, R. C., & Williams, T. M. (2017). Echolocation is cheap for some mammals: Dolphins conserve oxygen while producing high-intensity clicks. Journal of Experimental Marine Biology and Ecology, 495, 103–109. https://doi. org/10. 1016/j. jembe. 2017. 07. 002 The authors of this source provide useful information in describing the advantages that echolocation poses to dolphins such as allowing them to conserve energy when they whistle or click. They do not merely state the facts but provide statistical data that demonstrates this advantage. This source was helpful for the paper in providing the main form of communication in dolphins along with

providing a reason that describes how echolocation is advantageous to dolphins.

9. Thomas, J. A., Moss, C. F., & Vater, M. (2004). Echolocation in bats and dolphins. Chicago : University of Chicago Press, c2004. Retrieved from http://http://search. ebscohost. com/login. aspx? direct= true&db= cat06026a&AN= fiu. 021429210&site= eds-live The authors of this source describe how bats and dolphins use echolocations and how it is similar, but partially different in each due to the fact that one is a land organism while the other is a marine organism. This source is useful is providing background information on echolocation that is relevant in the paper to describe the form of communication in dolphins. It was incorporated in the section that compares the form of communication of the Common Bottlenose Dolphin to that of the California Sea Lions.

10. Vollmer, & Rosel, P. (2017). Fine-scale population structure of common bottlenose dolphins (Tursiops truncatus) in offshore and coastal waters of the US Gulf of Mexico. Marine Biology, 164(8), 1–15. https://doi. org/10. 1007/s00227-017-3186-x The authors of this source provide relevant background information describing where the Tursiops truncates can be found along with providing information on its morphology, diet, and social behavior. The source provides is reliable providing maps to pin-point their location along with providing numerical data to describe the common length and weight of this dolphin species. This source was incorporated in the introductory portion of the paper to introduce the basic information that one should know about the Common Bottlenose Dolphin.