

## RELATIONSHIP BETWEEN SLEEP AND EYE STATE IN CETACEANS AND PINNIPEDS

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### INTRODUCTION

Dolphins can sleep with one eye open. The hypothesis that this allows them to visually monitor the environment was proposed at the beginning of the 1960's based on visual observations (5). Later electrophysiological studies confirmed that dolphins can indeed sleep with one eye open at a time but the link between the eye state and the pattern of EEG in two brain hemispheres in cetaceans was obscure (17, 19, 20, 26). At the same time, visual observations provided a growing body of evidence that different cetacean species can rest at the surface, or slowly swim with only one eye open at a time (3, 12, 13, 16, 24, 27). The notion that unilateral eye closure indicates sleep in dolphins has become widely accepted by biologists, even though it has not been confirmed by experimental findings.

We recently investigated the association between asymmetry in eye state and uni-hemispheric slow wave sleep (USWS) in the beluga or white whale (14). This study revealed that the eye contralateral to the sleeping hemisphere was usually closed or in an intermediate state, while the eye contralateral to the waking hemisphere was predominantly open. With respect to the bottlenose dolphin, some EEG data and visual observations suggest a similar association in this species (19, 26).

Pinnipeds are another group of mammals that have adapted their sleep for the aquatic environment. Fur seals and sea lions, members of the family Otariidae, show interhemispheric EEG asymmetry during SWS, which is significantly increased when they sleep in water. In addition to this, and much like the dolphins, at least 2 fur seal species were occasionally observed briefly opening one eye while the other eye remained closed as they exhibited EEG slow wave activity (7, 8).

The aim of this study was to gather more information on the relationship between sleep and eye state in the bottlenose dolphin and northern fur seal. We also further analyzed the results of our earlier study of sleep in the beluga and compared them with new dolphin and seal data.

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