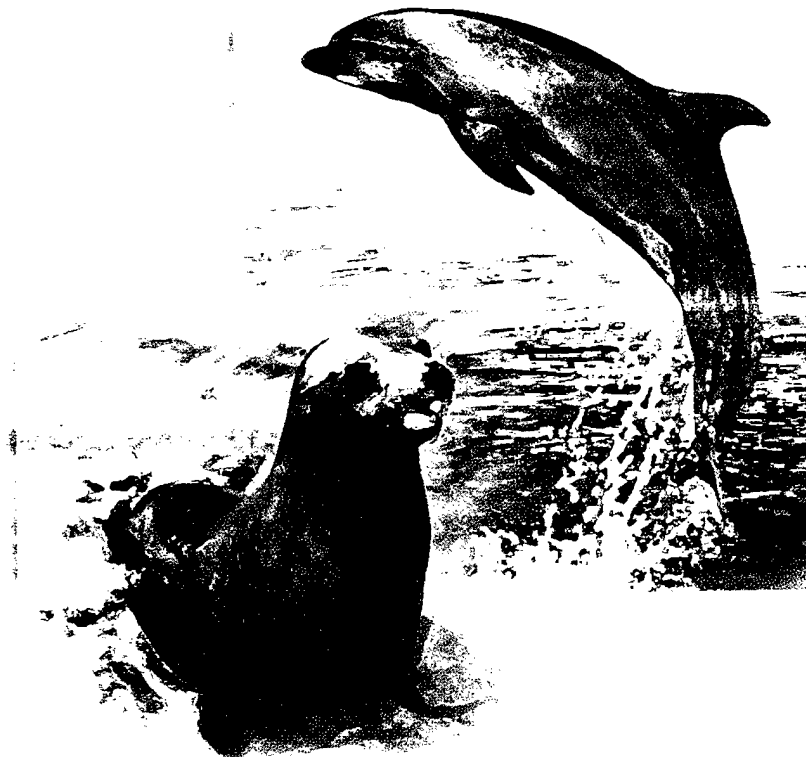


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U.S. Navy Marine Mammal Program

Space and Naval Warfare
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Our History

The U.S. Navy Marine Mammal Program began in 1959 at Marineland of the Pacific with a Navy scientist and a Pacific white-sided dolphin named Notty. The Navy was interested in the hydrodynamics of the dolphin. By understanding how dolphins move in the water, perhaps they could improve torpedo, ship, and submarine designs. Soon the Navy realized that there were lots of other good reasons to study dolphins. Like the Navy, dolphins use sonar. Dolphins are also capable of making repeated deep dives without experiencing "the bends" or decompression sickness as do human divers. This capability would make dolphins valuable assistants to Navy divers working in the open ocean. In 1962, a marine mammal facility was established at Point Mugu near Los Angeles. In 1965, in a program called SeaLab II, a dolphin worked in the open ocean off La Jolla, bringing tools and equipment from the sea surface to divers working 200 feet below. One of the great successes of SeaLab was the realization that marine mammals could do useful work untethered in the open sea. As Navy people worked with dolphins, they became fascinated with the adaptations these animals had to their aquatic environment. Soon, other studies including acoustics, diving physiology, anatomy, and medicine were underway. In fact, much pioneering work in the fields of dolphin hydrodynamics, acoustics, and diving was conducted by Navy scientists.

Operational Fleet Systems

From the capabilities demonstrated in the Advanced Marine Biological Systems program, four operational Fleet Marine Mammal Systems (MMS) have been developed to fulfill Navy requirements where hardware is inadequate or safety is an issue.

Dolphins are used in MMS because of their exceptional biological sonar that is unmatched by hardware sonars in detecting objects in the water column and on the ocean bottom. Sea lions are used because of their very sensitive underwater directional hearing and low-light-level vision. Both of these marine mammal species are trainable for tasks and are capable of repetitive deep diving.



Fleet MMS are assigned to Navy Explosive Ordnance Disposal Mobile Units (EODMU). Each system has from four to eight marine mammals, an Officer-in-Charge, and several enlisted personnel. All MMS are rapidly transported by aircraft, helicopter, and land vehicles with all equipment to sustain an operational deployment. These systems regularly participate in major Fleet exercises. The Mk 6 & 7 MMS were used to support waterside security at the 1996 Republican Convention in San Diego, CA. SPAWAR Systems Center, San Diego (SSC SD) supports these Fleet systems with replenishment marine mammals, hardware, training, personnel, and documentation.

What is a "System"?

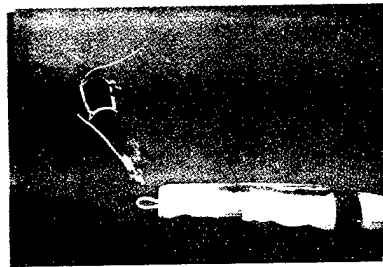
"SYSTEM" is the term used for the various marine mammal programs developed for use by the Fleet. Systems include:

Mk 4 is a dolphin mine-searching system that detects and marks locations of mines moored off the ocean bottom. Mk 4 is capable of shipboard for-



ward deployment to support post-amphibious operations. (EODMU THREE, Coronado, CA)

Mk 5 is a sea lion exercise mine-recovery system that locates pingered training mines. The sea lions



can locate these mines to depths of 1000 feet and attach a grabber device for recovery. (EODMU THREE, Coronado, CA and EODMU SIX, Charleston, SC)

Mk 6 is a dolphin swimmer and diver-detection system that can detect and mark the location of an intruder. This system was used in Vietnam in 1970-71 and the Persian Gulf in 1987-88. (EODMU THREE, Coronado, CA)

Mk 7 is a dolphin mine-searching system that detects and marks the location of mines on the ocean bottom. This system is also capable of ship-



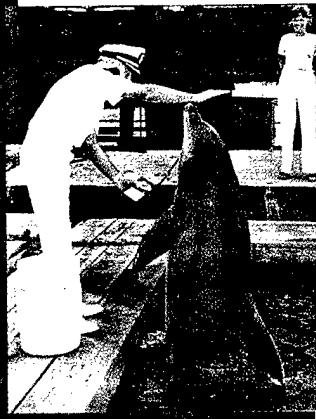
board forward deployment to support post-amphibious assaults. (EODMU THREE, Coronado, CA)

Marine Mammal Research

Some animals work for years in systems and then "retire" from systems work and go on to become star research animals.

Much of the pioneering research in the fields of dolphin hydrodynamics, diving, and sound capabilities was conducted by the Navy. In the late 1950s, the Navy developed an interest in many facets of dolphin physiology and underwater capability. By the early 1960s, the new Navy marine mammal facility at Point Mugu near Los Angeles was a hub for the study of marine mammals. The program continued to expand in its present location on Point Loma in San Diego, CA. Over the years, it has included studies on the development of improved techniques for diagnosis and treatment of health problems, investigations on how dolphins produce the sounds they make, and studies on capabilities of marine mammals, organochlorine contamination, nutrition, and hearing ranges of cetaceans. This information benefits all cetaceans from those that are sick and stranded to those cared for at marine mammal facilities. The program also benefits students, researchers, and veterinarians who get valuable exposure to marine mammal science at the Navy marine mammal facility.

MAUI WAS ONE OF THE FIRST NAVY DOLPHINS. HE WORKED FOR 35 YEARS IN THE MARINE MAMMAL PROGRAM. HERE, IN A PHOTOGRAPH TAKEN IN THE EARLY 1980s, MAUI IS RECEIVING AN AWARD FOR 20 YEARS OF NAVY SERVICE.



Marine Mammal Research (contd)

Current research addresses **ENVIRONMENTAL CONCERNS** and **BIOSONAR**. The following are just a few of the projects:

ENVIRONMENTAL CONCERNS: Two recent projects conducted at SSC SD will help researchers understand if, and at what levels, sound is harmful to marine mammals.

- In **DeepHear**, researchers tested the hearing of white whales (belugas) at different ocean depths. To do this, they trained the animals to dive to a platform as deep as 1000 feet. They then played different sounds to the whales. The whales whistled when they heard the sounds, showing that their hearing was just as sensitive at depth.



- In temporary threshold shift (**TTS**), researchers are testing the hearing of dolphins, whales, and sea lions to find out what sounds they can listen to without changing their hearing abilities.

BIOSONAR: Research shows that dolphin biosonar is better than any current hardware system available for finding objects in shallow water. Unfortunately, researchers do not fully understand dolphin biological sonar and search strategies.

- Through a project called **ALTER**, we hope to learn more about dolphin biological sonar. We hope to use this knowledge to develop new technologies that will improve current and future Fleet systems. The program is developing a computational model of the dolphin biosonar system that incorporates the animal's hearing system, search strategies, and classification capabilities for underwater targets. Researchers are also measuring the animal's hearing system for development of new transducer models that mimic the animal's signal production and receiving capabilities.



The Marine Mammal Program began with funding through the Independent Research Programs of the laboratories at China Lake and Point Mugu, supported by the Office of Naval Research. After the SeaLab II work in 1965 and successful missile recoveries off Point Mugu in 1966, an advanced development program was initiated. For a little over 20 years, the major components of the Navy Marine Mammal Program fell under a funding umbrella known as the Advanced Marine Biological Systems (AMBS) program. This advanced development objective funded marine mammal system (MMS) development, tests and evaluation, and systems design and development. While maintaining the care, health, and management of the animals, and research that supported marine mammals in the Navy, AMBS resulted in the successful development of the current MMS that are operational in the Fleet today. Supported by active Fleet systems, research continues to further understanding of the capabilities of the animals. This knowledge will be used to enhance current systems and to develop new system capabilities.

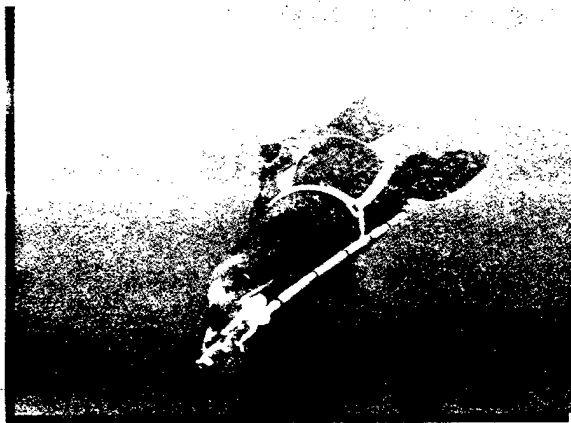


They Find Cars, Too

Navy marine mammals have been in the news for helping search for people and objects like cars under the water.

In 1993, a Navy-trained sea lion in Charleston, SC, helped the local sheriff's department find a car that had fallen into a river. Although human divers had tried many times without much luck, the sea lion found it!

On 21 May 1996, a boating accident occurred in San Diego Bay. Rescuers responding to the accident did not know how many people were on the boat, and those already rescued were confused and unable to help. A Navy marine mammal team working nearby with a dolphin responded to the search task and verified that all the victims had been rescued.



Dolphins and sea lions have also been trained to carry video cameras for underwater search operations. Perhaps these animals will become important in ocean search and rescue missions in the future.

Reviewed and approved by

A handwritten signature in black ink, appearing to read "A. C. Oakleaf".

A. C. Oakleaf, CAPT, USN
Executive Officer/Base
Operations Manager



Further Information:
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