Marine Mammals
Introduction

"Among dolphins an individual creates a game, others perfect it, and several play it. We have here intelligent creation, teamwork, and a capacity for attention which are very rare in the animal world."¹ Man has known for some time that dolphins are able to learn to perform many difficult tricks. However, only now are they understanding these animals have remarkable methods of communication. If this is so, what about other aquatic mammals, such as the walrus, horn-honking trained seals (as the California sea lions are erroneously called) and whales? Animal-film director Ivan Tors spent many nights with the white whale Namu and reported that the five-ton mammal was "the most intelligent creature I ever met."²

Pinnipeds, which include the true (or earless) seals, sea lions, other eared seals, and walrus', and cetaceans, which include the whales, porpoises and dolphins, are mammals living near or entirely in water. Aquatic mammals are descended from land mammals. They developed over millions of years special physiological adaptations for life at sea. For example, the flippers of present day seals gradually replaced the feet and legs of their ancestors. This modification of limbs hampers pinnipeds, or "fin-footed ones," on land but helps them to move more swiftly in water. Aquatic mammals have larger, longer lungs than terrestrial mammals. When the water-dwellers submerge, special muscles or valves contract to slow the flow of blood to the extremities, while allowing it to flow freely to

¹Robert Marle, The Day of the Dolphin, p. 17.
²William F. Evans, Communication in the Animal World, p. 119.
the heart and brain. The ears and nose also close when under water.

This paper will cover the various methods of aquatic mammal communication—visual signals, olfactory and tactile signals and auditory signals. Dolphin "sonar" and the question that has interested man for centuries, "Can we talk to dolphins?," will also be discussed.

Results of Research

Marine mammals do not have particularly good eyesight, although it is thought to be better developed in the pinnipeds than cetaceans. Occasionally, a sperm whale will lift his head to look about, and the bottle-nosed dolphin can see moving objects in air at about forty feet. Because their eyes are placed laterally—on the sides rather than front, cetaceans lack depth perception and stereoscopic sight. Their eyesight is further limited by the fact that ocean water is not highly transparent. The small eyes of whales, porpoises and dolphins can withstand extreme pressure when the animals descend to greater depths. They are equipped with special tear glands, which produce an oily substance for protection against irritation by salt water.3

Because of their limited eyesight, it is not surprising that aquatic mammals do not communicate through visual signals to any marked degree. The hooded seal of both sexes has an inflatable hood or pouch of muscle tissue (larger in the male), which extends from the nose to the top of the head. When angered or aroused, the seal inflates the pouch, which turns a brilliant red and lets out a roar that can be heard miles away. This audio–visual display is effective in frightening away potential enemies. Aside from displays involving territorial defense and mating, little is known about the visual signals of aquatic mammals.4

4Ibid., p. 64.
Seals and walruses are more gregarious than the land carnivores they were formerly grouped with. Few species are solitary, and the majority (notably the eared seals) live in colonies called rookeries, whose populations range from one hundred to one million. Possibly, mutual identification of parents and young are aided by the sense of smell. Although not especially well developed in pinnipeds, the sense of smell is utilized by all young mammals to a greater extent than the visual sense.

Whales and dolphins have little or no sense of smell. Their olfactory nerves are dead; olfactory bulbs—well developed in mammals with a keen sense of smell—are nonexistent in these animals. Although they have lungs and breathe like other mammals, cetaceans cannot live on dry land. Air breathing nostrils open externally through a blowhole (single in toothed whales, dolphins and porpoises and double in baleen whales) and are usually located on the highest point of the head. The lungs are connected directly to the blowhole, not to the mouth as in other mammals. Breathing is synchronized with surfacing. The blowhole automatically closes when the animal submerges.

Cetaceans have a keen sense of taste. They locate fish by means of sound and decide whether to eat it by tasting the water nearby first.

Tactile organs on the skin of aquatic mammals are numerous, and their sense of touch well developed. For example, the walrus and earless seals use their snout vibrissae, or whiskers, to locate food along the muddy floors of turbid water where they live. The sense of touch is important in the care of the young and courtship. The mother walrus defends and guards her young by carrying the calf on her neck even when swimming and diving. A courting pair of Falkland sea lions will climb ashore, sit facing each other and caress each other by twisting their necks from side to side like snakes. The female may even occasionally nibble the male's neck.

In the beginning, dolphin courtship is gentle. The male displays himself to
his lady friend, and a certain amount of nuzzling takes place, accompanied by high whining sounds. Finally, the male becomes impatient and speeds toward the female head on. The female races away and is pursued by the male. Both make great leaps out of the water, vocalizing loudly as they do.

Similarly, a pair of humpbacks will swim side by side exchanging blows. Like dolphins, they may throw themselves out of the water landing in a tremendous splash.

Like other mammals, marine mammals have internal ear structures with three bones in the middle ear. The auditory nerve connects the hearing apparatus to the brain, permitting sounds to be interpreted by the animal and allowing scientific brain-mapping experiments to take place. This has been performed with much success in the case of the dolphin. The brain-mapping procedure consists of having the animal anesthetized. The cerebral cortex is then stimulated by passing small electrodes into the brain at various points and applying a weak electrical stimulus. The dolphin is watched closely for response, including vocalizations. The brain area is concerned with hearing, vision, tactile sensation, body movements, and emotional response. If applied in certain areas of the brain, strong stimulus causes dolphins to emit distress calls. It may be necessary to increase stimulus in an area to elicit response.

Eared seals are noisy, while earless seals are quiet. During the mating period, cows and pups in a colony of eared seals may be heard howling and bleating. The loudest barks and roars, however, are those of the fully mature males. Within a rookery of eared seals there is almost constant uproar caused by these sounds. An occasional squall of a pup separated from its mother may be heard also.

In spring, eared bulls stake out territories in areas where they expect to breed. They declare their intention to defend the territories with loud roars. These animals are polygamous, gathering harems of cows ranging in numbers of ten to fifteen in the case of Steller’s sea lion, and up to a hundred in the case of
northern fur seal. The northern fur seal guards his harem jealously day and night, never leaving the territory long enough to seek food. He bawls defiantly to protect both the females and territory. He does not trust cows or neighbors and will sometimes fight with other bulls.  

Sea lion bulls, on the other hand, are more tolerant. The young male will bellow and roar although he has no harem to defend. He appears to be preparing for the end of his bachelorhood and when he can command his own territory. Female sea lions also vocalize, although their calls are of a higher pitch and lower intensity than those of the males. The calls of female sea lions are associated with mating and the care of young.

True seal sounds include low growls, snorting and blowing. These animals are promiscuous in their mating habits, although they do not congregate in large rookeries or harems. For example, the gray sea lion bull will fight for territorial rights but not for cows. Seals defend themselves by advancing toward intruders with their mouths open and uttering menacing cries or fleeing to water and diving in. At the end of the mating season, mature bulls will pull themselves on rocks to bask in the sunshine and bicker over favorite spots.

Young seals do not swim automatically; they must be taught. The Weddell seal mother, for example, employs the common, "Come on in, the water's fine," routine.  

Fourteen days after the pup's birth, the mother coaxes it to join her in the water. She plunges in and scrapes a ramp for the pup to slide safely into the water.

Several species of aquatic mammals demonstrate remarkable homing and direction-finding abilities. The harp seal lives in Arctic waters and reproduces in only three locations within its range—the White Sea, western North Atlantic and an

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5Ibid., p. 65.

6William F. Evans, Communication in the Animal World, p. 125.
area near Newfoundland. The seal migrates singly or in small groups to breeding places in the fall, then returns to northerly latitudes in the summer. The northern fur seal travels to breeding rookeries at a distance of almost nine thousand miles per year. The California gray whale navigates six thousand miles mostly in the open sea. This yearly migration is from the Arctic Ocean and Bering Sea to the California coast and back.7

Little is known of the communication of migrating mammals except for the short barks given by true seals to keep group members within certain areas. Professor E. J. Slijper, author of the book *Whales*, states that schools of cetaceans are kept intact by the use of sounds as a means of communication. After being scattered by whale hunters, whales may reassemble by the use of sound signals to each other. The mysterious mass suicides committed by whales—as much as a hundred beaching themselves on shore—may use similar signals.8

In Antarctica a few years ago, thousands of killer whales arrived at a fishing ground but were driven away by a single fisherman's quarry. One ship radioed a fleet of whaling vessels, and several whalers arrived. Only one shot was fired from a single harpoon gun. However, minutes later, not one whale could be seen in the fifty-square-mile area covered by whaling ships, and none returned. The one whale hit apparently sounded distress or alarm calls, and the information of danger lurking on the surface of the sea spread quickly.9

The entire life of the whale is bound with the ability to perceive and produce sounds. They hear sounds of the crustaceans they feed on and their fellow whales crying out in distress. Echo location—bouncing sounds off submerged objects to determine shape, size and distance—is used for securing food. Many

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8Evans, *op. cit.*, p. 125.
9Davis, *op. cit.*, p. 143.
naturalists and fishermen have reported hearing whistles and squeals also.

William E. Schevill and William A. Watkins of Woodshole, Massachusetts, recorded underwater cetacean sounds. They showed that animals use vocal sounds to convey definite meanings. Of the many sounds recorded, many of them were done with the knowledge of the circumstances under which they were made. Also known was their interpretive significance. These studies were made with hydrophones. The utilization of many sounds probably depends on echo location in locating and securing food and also for communication between individuals. The sperm whale produces numerous sounds, including a series of clicks, grating groans of a low pitch, rusty hinge creaking, and muffled noises.\textsuperscript{10}

Sounds of the white whale or beluga (a member of a dolphin-porpoise subfamily) were recorded by Schevill and Barbara Lawrence in the lower Saguenay River in Quebec. They found that the animal richly deserved the title "sea canary" because of its varied vocabulary consisting of ticking and clucking sounds, mews, chirps, resonating high-pitched whistles and squeals, bell-like sounds, and low trills. These sounds are generally too high for human ears to detect unaided. However, white whales occasionally emit sounds resembling a group of children shouting at a distance. These sounds are most likely produced by a stream of air bubbles from the blowhole rather than the voicebox.\textsuperscript{11}

Man has known for some time that dolphins are able to produce sounds and are affected by them. Aristotle claimed dolphins squeaked and moaned in air when captured, and other dolphins swam away quickly from these noises. Strangely, he believed they had no acoustic passageway.\textsuperscript{12}

\textsuperscript{10}Essie Forrester O'Brien, \textit{Dolphins—Sea People}, p. 70.


\textsuperscript{12}Bill Gilbert, \textit{How Animals Communicate}, p. 138.
Dolphins and porpoises are so closely related that their names are used interchangeably. The term "porpoise" is correctly applied to the round-headed mammals without beaks and laterally compressed teeth. Dolphins have beaks and spike-like teeth. Both are highly intelligent and favorites at various marinlands throughout the United States. They have been taught to retrieve sticks, jump through loops and perform a variety of tricks.

Most of what we know of dolphin communication comes from studies of the playful bottle-nosed dolphin (*Tursiops truncatus*) that weighs about three hundred pounds. Its brain weighs about three-and-a-half pounds—the largest brain for its size of all mammals except man. The brain is deeply furrowed, concoluted and highly developed. Some experts rank the intelligence of the dolphin between that of the dog and chimpanzee, and others say it even outranks the chimpanzee.\(^{13}\)

In 1953, W. G. Wood, curator at Marineland at St. Augustine, Florida, identified six sounds dolphins use to communicate with each other and for other purposes. The jaw clap, a flat, abrupt noise that resembles clapping, indicates a threat or warning and is used by the eldest male in the group. The short, flat whistle, followed by a high-pitched musical one, is a distress call. Dolphins within hearing range will respond to this call. A mother dolphin whistles to her baby, and the baby whistles back. The barking sound represents a warning or anger. This sound was recorded from an animal being pursued by a shark. Adult males emit yelping like a puppy's. This may be a mating call. Mewing and rasping may be heard while the animals are feeding. The "rusty hinge" sound is a dolphin's "sonar." This may be produced by rapidly pulsating clicks, which range from approximately half a dozen to several hundred per second. Because of this high rate, the sounds may be heard by humans only with special equipment.\(^ {14}\)

\(^{13}\)Esse Forrester O'Brien, *Dolphins—Sea People*, p. 138.

Other vocal sounds by dolphins include chirps, grunts, squawks, and sounds resembling the human voice. Only dolphins associated with humans produce loud singing sounds heard at oceanariums. Captive animals are more likely to produce sounds above water than free-ranging ones. Dr. John C. Lilly, the neurophysiologist, studied the dolphin brain. He was impressed by the sounds produced and was determined to learn their meaning. In 1955, he built a laboratory for this purpose in the Virgin Islands. While testing a dolphin in a tank, he called to his assistant "three-two-three," and the dolphin unmistakably imitated, "three-two-three."\(^\text{15}\)

Dolphins have no vocal chords, and scientists have had problems determining their method of sound production until recently. Lately, research conducted demonstrated that deep inside the blowhole in the nasal passage, two flaps or tonguelike projections overlap. Air through the nasal passage causes the flaps to flutter, producing noise. Variations in pitch are caused by increasing or decreasing pressure on the flaps. Besides the flaps, also in the blowhole is a movable "tongue" or "plug" that aids in the production of sound.

The frequency range of dolphin noise vibrations are three thousand to two hundred thousand per second. Noises resulting from the high-frequency vibrations include putting and creaking sounds. Whistling noises are often heard in the vocalizations of dolphins. They are of a fairly low range of six thousand to sixteen thousand cycles per second, each whistle lasting one-half second.\(^\text{16}\)

William Schevill and Barbara Lawrence carried out a series of experiments with a dolphin on Nantucket Island, Massachusetts in 1958. They discovered the dolphin could hear ultrasonic sounds in a far range and could perceive objects by means of reflected sound. They also demonstrated the dolphin uses the "rusty hinge" sound as an echo locating or sonar device.\(^\text{17}\)

\(^{15}\)Bill Gilbert, How Animals Communicate, p. 154.

\(^{16}\)Esse Forrester O'Brien, Dolphins—Sea People, p. 70.

Recorded sounds of dolphins (recordings slowed down for analysis) contain pings and resulting echoing pings clearly audible and visible on the oscilloscope screen. Captive dolphins accept fish only after transmitting sounds to fish and use echo location to find food. Tone varies with rate and is often emitted slowly enough to be heard separately. A tonelike effect results if the rate is increased to about two dozen or more per second. Sounds resembling groaning, moaning or moaning result if the rate is stepped up to over one hundred per second.

By bouncing sound off underwater objects, the dolphin determines the shape of the target or obstruction, direction and distance to it. For example, by using this method a fish is distinguished from a rock. The "rusty hinge" sound is the audible part of the sonar sound or series. Arthur McBride, first curator at Marineland at St. Augustine, discovered that bottle-nosed dolphins frequently swim around or jump over a fine mesh net. They avoid being caught in a net with a mesh size of ten inches or more. A fine mesh net probably appears to be a solid barrier because density reflects sounds, although some species of porpoises and river dolphins can avoid any mesh size.18

If a dolphin tank was purposely made turbid and fish were thrown in, a dolphin could still locate the fish. If it were blindfolded with suction cups placed over its eyes, the dolphin could still locate the fish, swim around without difficulty and surface with the prize in its mouth. Using the sonar in the same way, the animal navigates across muddy waters of docks and piers.

Whales and members of the dolphin family "see" objects through water by sending out messages, and both possess a rich vocabulary of other signals. Dr. Lilly, who has done experiments of this kind decided on studying the dolphin for several reasons:

... for example, the dolphin has a brain approaching man's in size and complexity; it probably has the ability to learn an interspecific

18 William F. Evans, Communication in the Animal World, p. 131.
language; it is similar to man anatomically and physiologically; it is not too large to deal with; an empathy is usually established between a subject and investigator; the dolphin can and does make humanoid sounds, often mimicking our speech; and at least one species—the bottle-nosed dolphin—is easily obtained in the warm waters along the Florida and Carolina coasts, near the Virgin Islands, and elsewhere.  

The young mammal is taught dolphin language twenty or so months before it is weaned. Lilly believes the cultural history of the species is passed on during this time. Dolphins have no written history and must use oral communication. Many primitive human tribes use this method today.

Communication of dolphins is probably complex and highly descriptive. Lilly believes these animals may be every bit as intelligent as man, although in a different way. He says some above-water sounds of dolphins—made only in the presence of human beings—resemble human laughter, whistles, cheers, and syllables in a high-frequency range. They try to communicate with man by lowering their vocal frequencies to audible ranges and vocalize in air rather than in water for human benefit. Lilly counsels that it is necessary to keep in mind that the subject must be exposed to human vocalizations for a long period of time and everything must be done to secure a mutual friendship between the man and animal.

Lilly coaxed dolphins into producing audible sounds in air or water. Human vocalizations were emitted alternately above and beneath the surface of the water. Underwater speakers and microphones, or hydrophones, were placed in tanks containing the mammals. They became accustomed to the sounds of human voices and in turn conveyed sounds to speakers in the laboratory.

The mammals initially emitted only the usual dolphin sounds. Later, whistling games were played between the dolphins and investigators. They mimicked many human sounds, including letters of the alphabet and laughter. These were often made and directed to the dolphins by Mrs. Lilly. The mimicking sounds are unintelligible until they are recorded and played back at a slower speed. It is evident that these big mammals compress our own drawn out words into tiny spurts

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19 Ibid., p. 131.
of continuous sound.

Conclusions and Recommendations

Cetaceans are the only nonprimates possessing a highly efficient and complex "language." Dr. Lilly's investigations will determine if extensive communication with them is possible, whether all dolphin "language" is the same and if there are certain "dialects" for different areas. Even if the efforts are unsuccessful, what has been learned from aquatic mammals can be applied to communication with other species.

The movie and novel *The Day of the Dolphin* by Robert Merle spurred my interest in the possibility of oral communication between marine mammals and man. Although fictitious, the story accurately portrays the intellectual capacity of the dolphin, an excellent representative of marine mammals.

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SEAMAN'S BEST FRIEND
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Abstract

This report includes the "how to's" and "why's" of dolphin training. Each stunt is taught in a unique way with constant attention and patience. Dolphins are trained to do stunts for marine entertainment parks in many places. Most of this research paper uses examples of the dolphins at Sea Life Park on Oahu. Dolphins are loveable and intelligent, the perfect animal for performances.
INTRODUCTION

Dolphins have been the subjects of books, magazine and newspaper articles, motion pictures, and television series and specials for several years now. People have had this great interest in dolphins for at least 2,500 years. We can find pictures of dolphins, or animals with a very similar likeness, on Greek coins and pottery along with drawings that were made before the time of Christ.

Dolphins have been the good friends of seamen for many years because the men thought that they brought them good luck.

The modern-day interest in dolphins began in the late 1930's. Just after W.W. II, people became aware of the fact that dolphins could be taught to do many tricks.

Dolphins are extremely responsive to humans, and they show a great deal of individuality in their behavior. This, along with their intelligence, tends to lead people, even those who use them as experimental subjects, to think of them as humans.

One area that makes the dolphin so advanced is their highly social behavior. This has been the cause for humans trying to communicate with them for so many years. Up to now, they have been unsuccessful, because they say humans are too dumb, but they are still trying.

In this report, we will try to cover the "how to's" and "why's" of training these marvellous geniuses of the sea.
SHAPING

Shaping is the reinforcement of a certain trick. The reason for shaping is to perfect certain stunts the dolphins already does naturally, or to add on to ones he has learned.

Shaping is the most important area of training. Actually, it is the main training for the dolphins. The reinforcement is usually a fish or a whistle blow. These are signals meaning "well done" or "keep trying."

There are certain steps to shaping a dolphin. In order to explain this I will use the example of a trainer who wants a pair of dolphins to jump over a bar.

Dolphins and porpoises are afraid of things that don't live in the ocean and seem to have no scent, sound, or movement. Naturally, the dolphins were frightened of the bar.

Step One was to overcome their fear of things like bars, while trying to give them some kind of idea of what was wanted. The trainer then put a rope on the floor of the tank. The dolphins refused to pass to the other side of the tank because it meant passing that strange object lying so still, maybe ready to eat them. So, the trainer tried bribery with fish. She got into the water with some of their favorite toys and called to them. They refused. She then got out of the tank and tried to scare them over the rope by throwing a beach chair at them. It worked! As they passed the rope, the reinforcement whistle came and many fish followed. They now weren't afraid of the rope and understood what was being required of them. After a few more crossing they were doing it readily on their own.

Step Two is to give them a challenge. The challenge was to lift the rope up halfway through the tank. This gave the dolphins a chance to make a mistake by going under the rope. Once they knew they had to go only over it, Step Three
Step Three was to gradually lift the rope to the surface so they'd have to jump over it, and not just swim over it. After they jumped the surface rope, it was raised higher and higher into the air. Each time they crossed the rope, they were rewarded. **THE DOLPHINS WERE SHAPED TO JUMP A BAR ABOVE THE WATER!!!**

**SIGNALLING**

Signaling is the use of cues to tell the animals when to do a particular stunt. The reason for signals is simply for communication between trainer and dolphins. The dolphin must learn exactly what that cue means and to obey it whenever it is heard.

There are two main types of signals. The first is hand motions and the second is underwater electronic sound systems.

For many years hand signals were used, but problems came up too often because of them. Different trainers had different signals, and even the slightest change will confuse the dolphin. Then they will go into a corner and sulk, get sick, etc... So, if a trainer had a day off or was sick, the shows just had to suffer. The second reason problems arose from hand signals is that dolphins are not seeing animals as much as they are hearing animals. The image of the signal is often blurred and once again the poor animal becomes confused.

The underwater electronic sound system is much more advanced and practical than simple hand signals. The advantages of the sound cue are great. If the dolphin is on the opposite side of the tank, the trainer doesn't have to get its attention so that the signal can be seen. Sound cues are heard throughout the tank. Next, dolphins are hearing animals, so they can easily distinguish one sound from another. Trainers are able to take vacations or rotate without the worry of the show suffering, since the sound cues don't change. The response
is also much faster. There are some problems with this system. The main problem is that the trainer himself cannot hear the cue while he's out of the water. There have been times when the trainer thinks that all of a sudden the dolphin forgot all he learned, or that he is sick, when it's actually because the main switch was not put on. These were the types of signaling.

There are also rules to signaling. They are extremely important so that the dolphins don't get confused.

A. Never time your stunts at exact intervals. The dolphins can pick up on this, and soon they'll be spacing their stunts at those intervals—not by the signal.

B. Leave the cue on longer than it's off, so they learn that the sound means to do the trick and no sound means no trick. This is called Stimulus Control.

STUNTS

Dolphins and porpoises have been trained to perform many tricks. These include high jumps, jumping over bars, doing the hula, wearing leis, beaching into a beautiful pose, ringing balls, and somersaults. Of course, there must be many others, but this proves the flexibility, intelligence, and friendliness found in these wonderful creatures.

High jumps consist of having the dolphin jump straight into the air to begin. Gradually the animal is only reinforced as he jumps higher than before. When the goal of the trainer is reached, a fish is held at that height and the dolphin's new goal is to get that fish! This is a relatively simple trick for a trainer since the animal is a natural jumper in the open seas.

Jumping over bars is a gradual process beginning with a rope at the bottom of the tank. It's then lifted halfway up the tank to reinforce going over
and not under the rope. Little by little the rope is moved up until the trainer has them jumping over the bar to her or his satisfaction.

The stunt of doing the Hula is actually the dolphin balancing on its tail fin in one area of the water. This is done by first reinforcing the tail balancing; then the trainer puts a hoop around the dolphin to keep it in one place.

You might not think wearing a lei is a stunt, but it is because plastic leis can irritate the dolphin's soft, sensitive skin. This stunt takes a lot of patience on the part of the trainer, and endurance on the part of the dolphin. The only way to teach this is to keep putting the lei on, enforcing it, putting it on again, etc...

Beaching is when the dolphin comes to the edge of the tank and pulls itself up to the deck. It then poses for us in a beautiful arc. This was taught when a dolphin would, out of play, beach itself and get reinforced.

When you see a dolphin ring a bell the next time you see a marine show, please appreciate it. This is a very difficult thing to teach a dolphin. The trainer must get into the water and sometimes push the dolphin's nose against a paddle to make the bell ring. The dolphin resents this, so it takes a lot of time, and patience. Once it is learned, the dolphin enjoys ringing it as a new toy. Again, reinforcement is used every time the bell is rung.

The somersault is another natural stunt that has to be enforced whenever a dolphin decides to do it. Since dolphins are quick to learn and like to do somersaults, it is easier to do than some other stunts. Reinforcement is absolutely necessary!

PROBLEMS

The first headache obtained by dolphin trainers is the problem of giving antibiotics to newly captured dolphins. The trainers complained that the antibiotics were the cause of fights and unhappy moments in the relationships between
dolphins and trainers, but the scientists claimed that they never administered antibiotics for "no reason." They later discovered the answer. When a dolphin is captured, its body can't fight off the new germs that he was never exposed to in the ocean. The animal's resistance to these germs is so low that he may die within four or five days in captivity. Aside from this problem, there are also many mechanical problems. The electronic cues used to signal the dolphins, along with the P.A. system, were exposed to salt water and weather conditions daily, which caused many problems.

The workers are human so some problems were mistakes. An example of this is when the chlorine drip for one of the tanks (chlorine was to prevent bacteria growth) was left too high, and the dolphin suffered for days. The trainers wondered why he wouldn't eat, and one day they found out. Someone had thrown a fish into the tank, and since the dolphin didn't eat it, it had to be taken out before it rotted. One of the trainers jumped in, and was instantly blinded. His eyes were quickly washed out until he could see again. The chlorine content was strong enough to bleach laundry.

The dolphins also put in their share of the problems. They thought it was fun to teeter over the walls of the tank. Because the water content was so high, they managed to get up there, but they often fell out onto the hard ground below. They suffered a few scrapes and bruises which wasn't what the trainers feared the most. They were afraid they might fall out during the night, dry out, and die. This could very well be, because if no one was around to put them back in the water, they could indeed die. If the animal was small, there wasn't too much of a problem; but when the 400 lb. bottlenosed dolphin fell out, it took lots of muscle to return it to the tank. The trainers would yell at them, but this just seemed to make the game more fun. Fortunately, they eventually got tired of this game.
Another favorite pass-time of the dolphins was smashing into the gates of their pens. Many dolphins have been known to break through their gates, and find their way into another dolphin's pen, even if they don't like their neighbor.

Dolphins do get angry with humans and other dolphins, but they will always give a warning by making a clicking sound with their blowhole, or they will "buzz" a swimmer, by zooming by and making an especially loud sonar blast. In some cases the next action might be to strike the swimmer or other dolphins with their tails or dorsal fins. In cases like this, the dolphin must be trained to do something else while swimmers are in the water, or if they can't be distracted from the swimmers, they must be penned up until the swimmers are out of the water. Although they might frighten people, they very rarely hit anyone.

Although there may be many problems involved with training these animals, there are far more rewards.

CONCLUSION

We hope that the readers of this report agree with us that dolphins and porpoises are extremely talented and loveable creatures. They seem to respect us as we should respect them. If they didn't we would never have been able to train them.

For further details and information, we recommend the book Lads Before The Wind. It's a very informative, factual book on the training of dolphins and porpoises at Sea Life Park.

NOTE: Although this report only refers to dolphins, porpoises are also subject to all areas of this report.
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HAWAII'S MARINE MAMMAL--THE HUMPBACK
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ABSTRACT

As man continues to invent more and more products, which need combustible substances such as oil, we also search near and far for these substances. Man has searched in the earth, by drilling through the crust in search of oil. But this wasn't enough. Man has also discovered that some whales are also rich in oil. One of the most common of these types of whales is the Humpback. They migrate to the Hawaiian waters annually. Here they are protected from whalers of other countries. My report is about this cheerful whale - the humpback.
INTRODUCTION

When the waters of the Arctic gets too icy cold, whales migrate to tropical seas. A lot of humpbacks are seen during the winter months in the waters between Maui, Molokai, and Lanai. They have been known to be the most athletic and playful of all whales.

CLASSIFICATION

The Megaptera Novaeangliae, better known as the humpback has many other names such as hump or bunch. These cetaceans are part of the Mystacoceti class of baleen whales. Baleen whales have no teeth and capture their food with the humpback's baleen or whale bone. But there are still further subdivisions, that the humpback is a part of. They are part of the rorquals of Balaenopteridae. This division has short baleens, a dorsal fin, and 70 to 100 grooves on their ventral side. (See Fig. 1)

CHARACTERISTICS

The Humpbacks are 40 to 54 feet long with huge flippers 1/4 to 1/3 of its total length. They can be easily identified from other rorquals because of their long, distinctive fins. These giants are averaged to be 29 tons which accounts for their speed. They are slow swimmers, as slow as 1.3 to 5 knots, therefore can easily be caught by whalers, using primitive methods. They have black tops and sides but their ventral side is white. One humpback whale was found to have 1000 pounds of barnacles adhered to it.
Fig. 1. The Humpback Whale.
INTERESTING FEATURES

These whales have gained a reputation for being the most athletic and playful of all whales. Their frequent leaps clear out of the water, partially spinning and falling back with a mighty splash can be heard and seen for miles.

Humps are often known as the singing whales. The humpback has a long and complicated, melodious song, which is also unique from other whales. It has been studied and found to have a definite pattern and has been used as the background of a new symphony. Whale watchers have been observing the song to be changing every year and has determined that the Atlantic and Pacific humpback whales' songs vary in composition. Their song usually lasts 3 to 36 minutes but has been recorded for hours or more depending on the certain singing humpback. The song has been heard to be repeated almost identically with the only difference in the tone. Scientists believe that higher notes indicate the changing of their feelings. Humpbacks are able to find each other over large stretches of ocean. With their low-frequency sounds throbbing outward for miles and miles, they communicate information about their species and location, if there are no obstacles.

As you might already know, humpbacks are very friendly. If you are aboard a ship cruising in the waters between Maui, Molokai, and Lanai, and a few black sea creatures with spouts come suddenly swimming along the side of the ship, do not be afraid for they are the friendly humpbacks. They are known to come from the sea, unexpectedly and sail with ships that are not whaling ships. They have been known also to support a wounded comrade until thy themselves fall victim to whalers. Humpies also come to the assistance of pregnant females and their young.
REPRODUCTION

The humps migrate to Hawaii, some to mate, others to give birth. Scientists have watched the bulls, or male whales, when attracting attention of the cows or females during mating season. They stand with their heads underwater, while smacking their tail flukes on the surface. (See Fig. 2) Once the bull attracts attention, they both may rise vertically out of the water with their stomachs facing each other. (See Fig. 3) Observers have agreed that the mating act is preceded by prolonged and tender foreplay. For example, the pair could make swimming motions in each other's direction and stroke each other with their bodies and flippers.

Both sexes have the same organs as do all other mammals. Except that the male' testicles do not lie in a scrotum outside the body, but at the rear of the abdominal cavity behind the kidneys. The females sex organs are in the exact same place in the abdominal cavity as the male's testicles are.

The females sex organs consists of a vagina with a heavily folded mucous membrane, a two-horned uterus, the Fallopian tubes, and the ovaries. The ovaries of the humpback look like clusters of grapes. A pink corpus luteum develops form the empty follicle shell after ovulation. It produces hormones which helps the embryo, attach to the wall of the uterus. Like all mammals, if the ovum is not fertilized, it will shrivel. The newborn comes into the world, tail first and must be able to swim to the top, for his first breath. Once the calves are born, they are like cow calves. They get their nourishment from their mothers, but they cannot recieve warmth from her, and they must swim along her right side. The chances for a female whale to give birth to twins and triplets are the same as a human beings.
The birth process of the great whales has never been observed. The
information that I have found was only from females that were stranded
or captured during birth. There is no way for whalers to know that whale
cows are pregnant until they are harpooned. This is why, there is not much more
whales in the world today. Whales are like people, but they can not keep
up with mankind. Female whales can only bear between 6 and 15 young
in her lifetime of 15 to 30 years. If she is allowed to live that long.

CONCERNING HAWAII

In Ancient Hawaii, whale meat had a minor importance as food source.
When whales were washed on the shores they were valued and were the property
of the chief. Whaling was important to Hawaii because whalers used the
islands for refueling and supplies. This lasted 50 years, from 1830 to 1850.

Pleasure crafters today, on the Kona coast of the Big Island, are
worried about the danger of whales leaping clear out of the water unexpectedly
and crushing the boats.

PROTECTION

The humpback whale was adopted by the Hawaii State Legislature in 1976
as the official marine mammal of our state. Waters between Maui, Lanai,
Molokai, and Kahoolawe were declared the first whale preserve in the
United States. This proclamation states that the migration months for
humpbacks, December to May, will be whale reserve months in the county of
Maui. The humpbacks are protected from whalers during these months.
In the beginning of this century the humpbacks were not considered endangered. Only in the late sixties humans began to realize that the whales of the world were in the process of extinction. But nothing was done, until the United States proclaimed the Marine Mammal Protection Act of 1972 and the Endangered Species act of 1973. Many organizations were established to save the whales.

The most famous, in Hawaii, is Greenpeace. It operates out of Vancouver, British Columbia, and has a branch in San Francisco. Greenpeace believes in the direct approach. They look for whalers. When they spot pods of humpbacks, or any other whales, they send rubber boats to go between the whales and whalers' harpoon boat. Many people are now aware of the near extinction of whales and other cetaceans. But there are still some who need these whales to live.

CONCLUSION

I have never seen humpback whales before. But as humpbacks still live in the world's waters today, I hope there will always be these friendly, athletic, playful, and harmonious whales in my years to come. I have learned a lot about the humpback. But there is still more to know. The world should realize the happiness of having such sea mammals to delightfully watch and someday learn more about.
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REPRODUCTION OF HUMPBACK WHALES
by Angela Park, Hana High School

INTRODUCTION

What kinds of safety laws and programs are there for humpback whales? Why have they become an endangered species? Humpback whales are enormous animals, when fully grown, they are 45 feet long and weigh over 40 tons. Newborn calves weigh close to 2,000 pounds. They are non-aggressive and show no feeling of hatred toward man; they are usually known as the peaceful giants.

RESULTS OF RESEARCH

Humpback whales are the most common off the coast of Washington and all around the Hawaiian Islands. The whales have gained a reputation of being most athletic and playful by the way they leap clear out of the water, spinning and falling back with a mighty splash.

Their main foods are anchovies and krill, which are found in the northern fishing grounds and are gathered from May to December. Krill are shrimp-like animals that measure up to 2½ inches in length but are usually only 1½ inches long.

The humpback is up to fifty-four feet long with huge flippers that are one-fourth to one-third its total length. The average length of a humpback is forty feet.

It has an average weight of twenty-nine tons. These whales are slow swimmers and can easily be caught by whalers, who use primitive methods. They stay under water for four to seven minutes between breaths.

The humpback has a low, broad, jet-shaped spout, that goes along with a puff. Humpbacks' reproduction involves considerable loveplay. They do it by caressing each other, slapping each other with their flippers or gently
swimming past one another with bodies gently touching. They mate, facing one another, chest to chest, and rising to the surface at great speed. The gestation period lasts ten to thirteen months. The calf is sixteen feet long at birth. At three years sexual maturity is reached in both male and female humpacks.

Humpback whale courtship usually involves a lot of leaping and splashing out of the water, and playful taps with their flippers. As soon as the excitement is over, the pair mate belly to belly, usually lying on their sides or sometimes rubbing themselves together in a vertical position in the water.

The single young calf is born tail first, otherwise the calf might drown while coming out from its mothers' body.

Most whale mothers are protective and caring toward their young. Among different types of whales that travel together in groups, an "auntie" or "midwife" often swims close during the birth process and helps the mother push the newborn to the surface to get its first breath of air.\(^1\)

The nipples of the mother whale are enclosed in slits, one on either side of her reproductive opening. Whale milk is a rich and highly condensed food, consisting of as much as 40 to 50 percent fat and 12 percent protein. On this fare, the youngsters grow quickly and steadily.\(^2\)

The whales' sense of smell is of little use, because during dives their nostrils are closed tightly. Above their eye is a tiny opening, almost invisible and about the size of a pencil lead, which is the ear. In spite of this small opening, the whales' hearing is very sharp. It receives many sound vibrations through its head and the forward portion of the body. The sounds are thought to be produced by methods that include the movement of air in the nasal passages, since the whales have no vocal cords. Whales use a variety of sounds to locate one another in the ocean and to communicate. Often a mix of pure notes, chirps and chords; these whale sounds can be very powerful.
Like all other marine mammals, whales descended from early land mammals that, at some point in their evolution, returned to the sea. Some sixty million or more years ago, whales, along with dolphins and sea cows, came from plant-eating, hoofed mammals that adapted to life in the sea. Gradually developing and changing over a great period of time, the whales became one of the most specialized of all modern mammals. 3

For centuries, men of many nations have been killing them off, in tremendous quantities. They killed whales for a lot of things, such as oil for lamps and a high grade lubrication oil, male whale cells for candles, ambergris for the best perfumes, and whalebone for padding and undergarments.

The Washington State Commerce Committee approved a bill restricting the capture of killer whales for display in commercial attractions. In 1935 a serious attempt occurred to slow down the killing of whales in the Antarctic. It happened when the whaling nations agreed to forbid the hunting of right and bowhead whales, which were almost extinct by this time, and to stop the taking of female whales while a calf was nearby. In 1966 the International Whaling Commission (IWC) finally protected both blue and humpback whales. The action was almost too late, for both species were already close to extinction.

There are two federal laws that protect the humpback whales. Both the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973 prevent the taking of humpback whales.

On December 12, 13, and 14, 1979, on Maui, there was to be an important meeting discussing a proposed sanctuary for humpback whales in the Hawaiian waters.

Scientific experts and government officials were to attend the meeting. According to Jo Ann Chandler, acting director of the Sanctuary Management Office, the objective of the meeting was to come up with some guidance from a scientific perspective as to what program is best. Ms. Chandler was quoted
as saying, "It is a three-day scientific gathering which brings together many of the top national and international experts on the subject that will cost about $10,000."

According to a 34 year old former San Francisco attorney, "It is clear that the humpback has been, is and will be put together by human activity."

Since there was an increase in the number of people expected to attend the meeting for the protection of the whales in Maui's waters, the Lahaina Restoration Foundation decided to reschedule the opening sessions. The three-day public session was held in the Mokihana Room of the Maui Surf on December 12.

The workshop was sponsored by the Office of Coastal Zone Management of the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce.

According to a Coastal Zone Management statement, the humpback whales come to Hawaiian waters each winter to calve and raise their young, as well as court and mate. Their conservation depends, partly on the protection of the species during crucial periods in their life cycle.

Among the topics discussed were: the life history characteristics of the humpback whales, experimental conditions necessary for survival, activities which may affect the whales, potential mechanisms to increase the present protection of the whales, criteria which local, state, and federal action should fulfill, and research and public education priorities.

"The meeting was the result of a 1977 proposal, written by James Hudnall, asking for a protected sanctuary in the waters bounded by Maui, Molokai, Lanai and Kahoolawe." "This is the second time a group of scientists have met in Hawaii to discuss the problems of the humpbacks." "The result of the workshop was a definition of harassment which federal agents could use to enforce the Marine Mammal Protection Act." "The panel is proposing the sanctuary extend
from Kuala Island to the Big Island, covering the waters from the shore
out to the 100 fathom ledge.°

"Instead of Hudnall's proposal, he recommended the panel consider establishing
a 24-hour whale hot line to take calls on harrassment, as a depository for data
collected by scientists on the humpbacks in Hawaii, and uniform harrassment
rules enforced all over the Hawaiian chain."° The panel ended December 14, and
will publish its recommendations in February.

CONCLUSION

I have chosen this area to study, because I feel that saving the humpback
whales is a very protective thing to do. Although I do not know too much about
humpback whales, I for one, think that having a sanctuary for humpbacks is the
greatest thing anybody would consider doing. By doing my research on humpbacks,
along with their characteristics, I have felt myself become more interested
to know more about them, such as, what is really going to happen to them in
the near future.

I have done quite a lot of research on these whales and now, looking over
it, I am glad that I was able to write a paper about this important type of
whale--the humpback.
FOOTNOTES

1. Robert M. McClung, Hunted Mammals of the Sea

2. Robert M. McClung, Hunted Mammals of the Sea

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4. Jeanette Foster, "Whale Talks Finally Take Place,"
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