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A Corral System for Examining Pelagic Dolphin Schools

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ABSTRACT—A research platform was developed for study of schools of wild pelagic dolphins. The Porpoise School Impoundment System (PSIS) was designed to safely handle schools of up to 500 animals in a manner compatible with standard fishing procedures of tuna purse seine vessels. The PSIS attaches to the purse seine net to receive the dolphins as they are released from the net. The compartmentalized apparatus has a corral capable of holding up to 120 dolphins. The animals are maneuvered to chutes where they can be individually examined and prepared for other studies. They can be released individually or held in holding pens for release together. The PSIS was used during two cruises for coordinated studies involving capture of 1,319 dolphins. The system proved to be a safe and effective platform for open-ocean studies of wild dolphins.

Introduction

Several species of small cetaceans, primarily dolphins, are involved in the purse seine fishery for yellowfin tuna, *Thunnus albacares*, in the eastern tropical Pacific. Cetacean mortality in this fishery has been reduced from an average of 309,000 in 1971 and 1972 (Fox, 1978), to about 19,000 in 1978 (Smith[1]). This reduction in mortality is mandated by the Marine Mammal Protection Act of 1972, which also requires continual assessment of the dolphin stocks to assure that they are properly managed through regulation of the fishery.

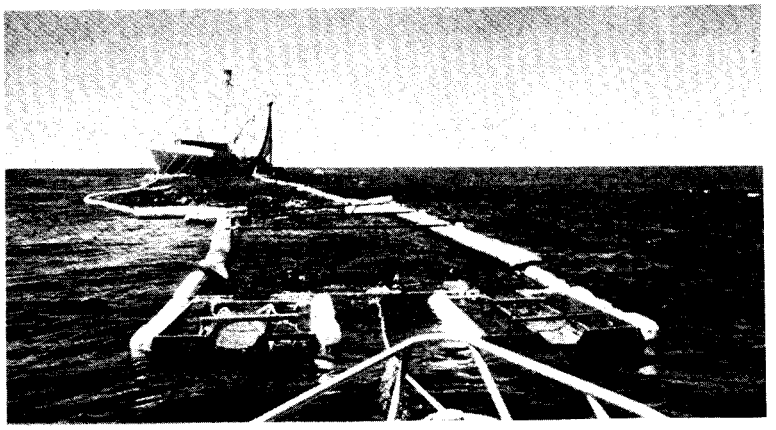
Several assessment studies required a mechanism by which large groups of dolphins, caught by the tuna purse seiners, could be safely contained, examined, and released. These studies included examination of dolphin schools for species, age, and sex structure; investigation of school dynamics by radiotracking; and study of short-term school cohesion and integrity as well as long-term distribution and movements by tagging.

No system or technique existed for holding and handling whole dolphin schools; the species involved in the fishery have schools averaging about 500 animals. However, much information was available on the holding requirements of captive dolphins in pool enclosures. Standards for the handling and transportation of these animals have been developed by the U.S. Department of Agriculture (1979). Irvine (1970) described a lightweight, portable holding pen designed to be rapidly deployed at sea from a vessel or helicopter, but the pen was designed to hold only a single trained dolphin.

The primary design requirements were: 1) That the system be safe for dolphins and personnel alike while in the water and during deployment and retrieval from the vessel, 2) that the system be capable of holding whole dolphin schools of up to 500 animals for simultaneous release as well as for release of individual animals, and 3) that the system be compatible with the vessel's standard fishing operations.

During these operations, dolphins are released from the purse seine by a process known as "backing down," which involves the ship's manipulation of the

[1]Smith, T. D. (editor). 1979. Report of the status of porpoise stocks workshop (August 27-31, 1979, La Jolla, California). Admin. Rep. LJ-79-41, Southwest Fisheries Center, NMFS, NOAA, P.O. Box 271, La Jolla, CA 92038.



The Porpoise School Impoundment System in operation during a research cruise of the Cooperative Dedicated Vessel Program. Porpoise are being maneuvered from the tuna purse seine into the corral for examination and tagging.

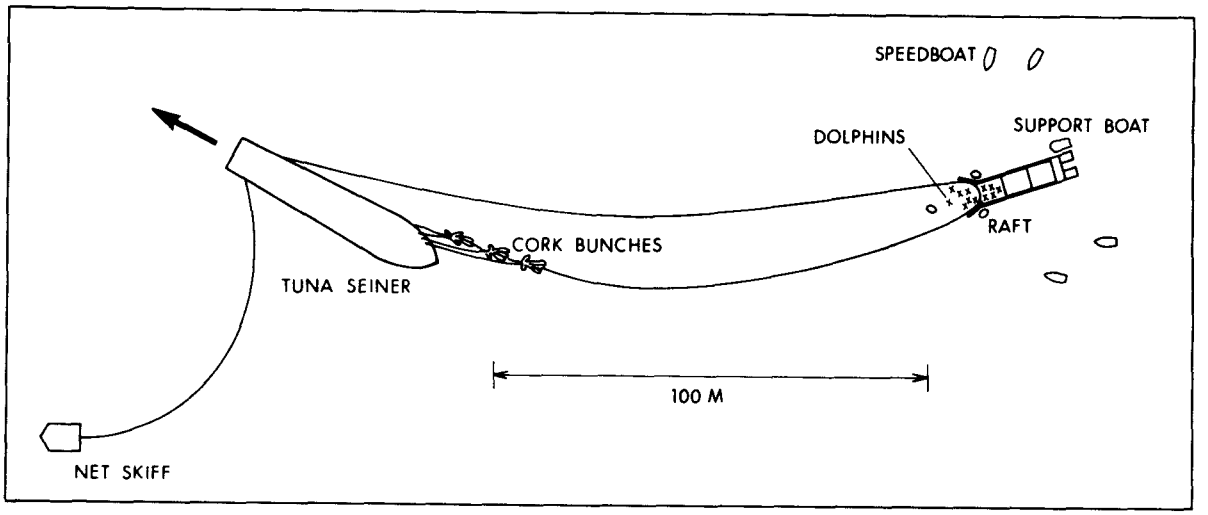


Figure 1.—The PSIS attached to the purse seine net during backdown.

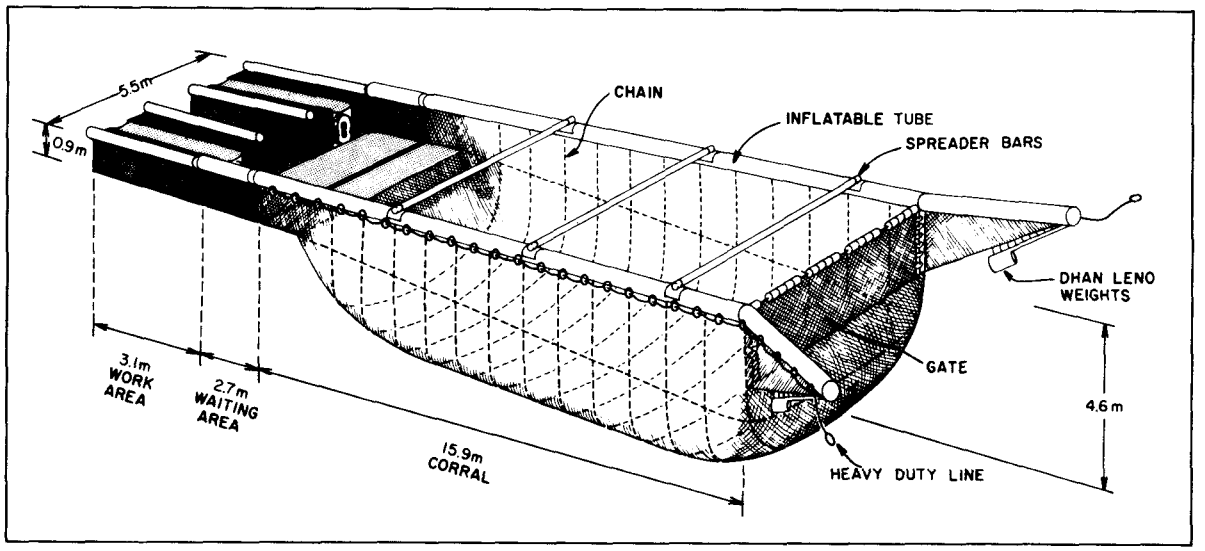


Figure 2.—The PSIS without the pens.

net into an oblong shape while the dolphins position themselves at the end farthest from the vessel. The net is then essentially pulled out from under the dolphins (Perrin, 1969; Coe and Sousa, 1972). The corral system was designed to be compatible with this release technique. It attaches to the backdown area of the net to catch the dolphins as they leave the purse seine (Fig. 1).

The research was made possible by the cooperation of the United States Tuna Foundation which provided the vessel, the *Queen Mary*, for a year to study the porpoise-tuna problem. The program was known as the Dedicated Vessel Program.

Materials and Methods

The Porpoise School Impoundment System (PSIS) (Fig. 2, 3) consists of a

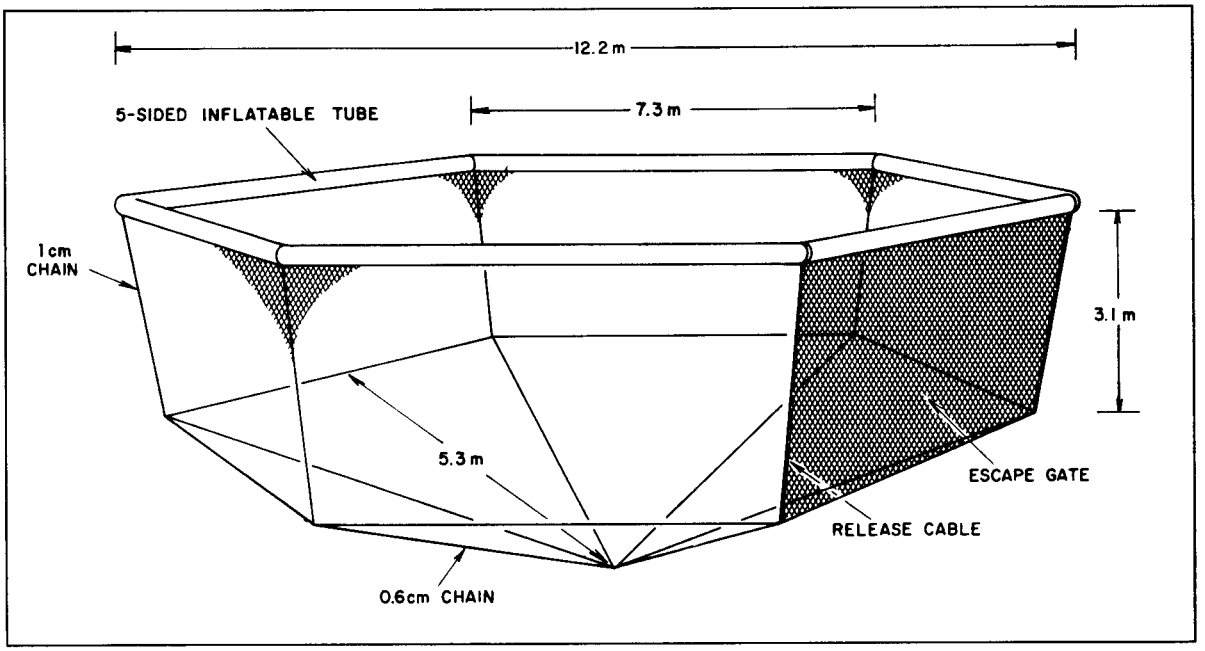


Figure 3.—A holding pen of the PSIS.

"corral" of webbing into which large portions of the school are transferred from the seine and held prior to examination; a "waiting area" of expanded aluminum mesh in which the dolphins are maneuvered individually to the chutes; two "work areas" with chutes in which the animals are measured, examined, tagged, etc.; and five "holding pens" in which groups of dolphins can be held until the school is released as a unit.

The dimensions of the corral and holding pens are based on estimated space requirements for temporarily holding individual wild dolphins. Minimum space is allowed in the corral, since the dolphins spend relatively little time in this component; allowing too much swimming room would complicate catching individual animals and prolong the operation. More space per individual is allowed in the holding pens where the dolphins could spend several hours. Both components allow for the estimated natural turning radius of 4.9 m required by an adult spotted dolphin (Pryor[2]).

The dimensions of the noncollapsible components were limited by the storage space available on the deck of the chartered medium-sized (500-ton) purse seiner and by the number of scientists the vessel could house to deploy, operate, and retrieve the PSIS. Modifications of the system were made after an initial feasibility cruise.

The Corral

The corral (Fig. 2) measures 15.9× 5.5 m, with the depth decreasing from 4.6 m at the mouth to 0.9 m at the waiting area. The shape at the surface is maintained by rigidly inflated 40.6 cm diameter nylon-reinforced polyvinyl tubes and 7.6 cm diameter aluminum spreader bars that mount into aluminum saddles on the inflatable tubes. The tubes are inserted through the sleeves formed of webbing. The weight of 0.6 cm and 1 cm galvanized chain is used to maintain the subsurface shape, especially when the corral is under tow during "backdown." Heavy-duty 2.5 cm braided nylon lines run along the base of the inflatable tubes to absorb the strain on the system when it is towed through the water. These lines run from steel rings on the purse-seine corkline to the work area. The corral weighs about 545 kg.

The corral attaches directly to the purse seine. The inflatable tubes are flared at 45° angles and have weighted net wings to prevent dolphins from escaping over the corkline and to funnel them through the gate of the corral. The gate consists of a 7.3×3.1 m panel of webbing with a corkline. The panel is lashed directly to the corkline of the purse seine, so that they sink and rise together during "backdown." After the

[2]Pryor, K. 1979. Report to the National Marine Fisheries Service on sea tests of the Porpoise Impoundment System, March 3, 1979. Dolphin Behavior Consultant, 28 East 10th Street, New York, NY 10003.

dolphins are in the corral, the lashings are cut to allow the gate to rise, blocking the opening. When the last batch of animals is transferred into the corral, the PSIS is detached from the purse seine.

A 4.6 m deep crowder net is placed in front of the gate and used to maneuver the dolphins toward the waiting area. The crowder net is hung from a floating polyurethane-foam bar and is weighted with chain. It is maneuvered with lines passed through pulleys in the waiting area.

The Waiting Area

The corral webbing attaches directly to a rectangular platform of expanded aluminum mesh buoyed by hollow, watertight support beams. Although the waiting area is neutrally buoyant, a series of 30 cm dock bumpers provides additional flotation in case any of the hollow members flood and protects the structure upon impact with the vessel during deployment and retrieval. The waiting area is about 5.5 m wide and 2.7 m long, with four walls, 0.9 m high. One wall is hinged to fold down when in use, extending the walking area by an additional 0.9 m. (When stored on the vessel, this wall is folded up to minimize space.) Standing waist deep in water, scientists can catch and lead the dolphins to the chutes. This component weighs about 454 kg.

The Work Areas

The two work areas are of construction similar to the waiting area. Each measures 3.1×1.8×0.9 m and contains a center chute with a walkway on each side. The chute of clear plastic is marked in 1 cm increments to allow for rapid measurements of dolphins. Polyurethane floats on both sides of the structure provide additional stability and safety. Interlocking automobile tires are placed between the waiting areas to allow for articulation between the components, to keep them aligned, and to prevent the aluminum structures from damaging each other. Each work area weighs about 182 kg.

The Holding Pens

Original research plans called for release of intact schools of up to 500 dolphins after examination and tagging. Five pens were designed to hold 100 dolphins each for up to 12 hours. In addition to allowing for more space per individual than allowed in the corral, the pens were designed without corners because wild pelagic dolphins do not negotiate corners. The pens are hexagonal and have sloping floors (Fig. 3). The hexagonal shape allows the pens to be efficiently clustered and monitored.

Each pen measures about 7.3 m on a side, 12.2 m in diameter, and has a center depth of 4.6 m. The subsurface shape is maintained by weighting the net with 0.6 cm and 1 cm galvanized chain. Nylon-reinforced polyvinyl inflatable tubes of 40.6 cm diameter maintain the hexagonal shape and keep the pen afloat. One side of the pen has a separate inflatable tube that is part of the release gate. The gate consists of a separate panel 7.3 ×3.1 m laced to the adjacent panels with plastic-coated steel cable strung through brass rings.When the dolphins are to be released, an aluminum spreader bar is placed across the opening, the inflatable tube is removed, and the gate is dropped by pulling the cables.

General Safety Features

All netting is of 3.2 cm stretch-mesh webbing, which has been demonstrated to minimize ensnarement of dolphin teeth and fins (Barham et al., 1977). In order to reduce abrasion of the dolphin skin, knotless webbing is used, all exposed metal edges have been filed smooth, and the expanded aluminum structures have been coated with a slick tar-based paint. All components of the system are attached so no gaps exist in which dolphins can get caught or through which sharks can enter. Heavy chains maintain the shape of the nets so that no "canopies" can form which might entrap the animals. Quick-release systems are designed into each component of the PSIS in case of emergency. The aluminum-mesh webbing provides protection from sharks. Extra flotation is provided in the event a hollow aluminum member floods, and battery-powered air pumps are available to compensate for any leaks in the inflatable tubes of the corral or holding pens. A complete above- and underwater lighting system has been developed in case operations continue into the night.

The PSIS was used during two 60-day research cruises aboard a chartered 500-ton fish carrying capacity tuna purse-seine vessel. The research was conducted in the vicinity of Clipperton Island off Mexico. The primary objective of the first cruise was to determine the feasibility of using the system to examine and tag whole schools of spotted dolphins, *Stenella attenuata*, of up to 500 animals. Capture and retention of whole schools was found to be very difficult, as portions of the school evaded capture or escaped when being transferred from the seine into the PSIS. Considerable caution was used while operational techniques were developed and environmental limitations defined. A total of 611 dolphins was captured in four net sets; 447 of these were examined for age and sex. The largest group consisted of 204 dolphins. A total of 17 dolphins was accidentally killed during the operation: 11 died in the seine or corral, 1 was killed by a shark outside the PSIS, and 5 died as a result of entanglement in the webbing. The cruise report[3] summarizes the results of the research.

Inadequate space on the vessel for storage of all five holding pens and for housing additional personnel prevented full use of the pens. One pen was used to hold 53 spotted dolphins for 7.5 hours, with no observable signs of stress and no mortality. Holding was terminated just after dark, otherwise no night work was done on either cruise.

During the second cruise, the PSIS served as a platform for a coordinated series of studies including examination for age and sex structure of schools, tagging for long-term movements, tetracycline injection for age determination, blood sampling for analysis of

[3]Coe, J. M., J. G. Jennings, C. B. Peters, and J. DeBeer. 1979. Research related to the tuna-porpoise problem: summary of research results from the second cruise of the Dedicated Vessel, 17 April to 5 June, 1978. Admin. Rep. LJ-79-6, Southwest Fisheries Center, NMFS, NOAA, P.O. Box 271, La Jolla, CA 92038.

physiological capture stress, and radio-tracking for study of short-term school cohesion. During nine sets, 872 dolphins were examined, 656 were tagged with dorsal-fin tags, 331 received tetracycline injections, 49 had blood sampled, and 6 were radio-tracked for three 2-day tracking sequences. The largest group examined consisted of 164 spotted dolphins. Thirty-six dolphins were accidentally killed: 21 died within the PSIS, 14 died in the purse seine, and 1 died after being entrapped between the seine and the corral[4].

Conclusions

The feasibility of using the PSIS as a research platform for study of wild pelagic dolphin has been demonstrated. One thousand three hundred nineteen (1,319) dolphins were successfully examined, with very low mortality. Although the system was never used to its design capacity of 500 animals, handling schools of this size should be possible if all conditions are ideal.

Major limitations on the use of the system include environmental conditions, species composition of the school, available daylight, and number of people available to operate the PSIS. To be safe, sea state should not exceed Beaufort 3 and winds should not exceed 12-14 knots. Special attention should be paid to impending weather. Spotted dolphins, *S. attenuata*, are generally calmer animals and are considerably easier to handle than are spinner dolphins, *S. longirostris*. The more active spinners require additional space and close monitoring because there is a greater risk of mortality or injury. Since it is advisable to conduct all activities in daylight, the time of day the school is found and operations can commence is critical. Generally, 5-6 hours are required from time of deployment to retrieval of the PSIS. Operation of the system without the holding pens requires 8-10 persons. A detailed operations manual[5] is being prepared.

The limits of the system are defined. The corral can hold a maximum of 120 dolphins, with no more than 50 spinner dolphins if the species composition of the school is mixed. While the largest school contained 204 animals, processing larger schools should be possible by repeatedly placing groups of about 120 dolphins in the corral during multiple backdowns. The maximum holding capacity for each pen is 75-100 dolphins.

Simultaneous release of animals from more than one pen would be difficult. The pens tend to collapse when being towed, and since the backdown procedure requires pulling the net through the water, a pen of dolphins would have to be set adrift with attendant personnel before backdown. The pens therefore could become widely separated. Additional personnel and boats would be required to monitor the pens and release all groups simultaneously. The dolphins would probably regroup after release.

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[5]Coe, J. M., J. G. Jennings, R. W. Butler, and W. E. Stuntz. In press. An operations manual for the Porpoise School Impoundment System (PSIS). NOAA Tech. Memo., Southwest Fisheries Center, NMFS, NOAA, P.O. Box 271, La Jolla, CA 92038.