PASSIVE BEHAVIOR BY THE SPOTTED DOLPHIN, *STENELLA ATTENUATA*, IN TUNA PURSE SEINE NETS

The purse seining method of catching yellowfin tuna, *Thunnus albacares*, in association with schools of dolphins in the eastern tropical Pacific has been described by Perrin (1969). The primary target species, in order of importance, are the spotted dolphin, *Stenella attenuata*, and the spinner dolphin, *S. longirostris*, with occasional net sets made on schools of the common dolphin, *Delphinus delphis*. Schools of these dolphins ranging in size from 50 to several thousand are herded with speedboats and encircled with a purse seine net that is from 900 to 1,400 m long and as much as 130 m deep. After the dolphins are encircled, the bottom of the net is pursed, entrapping the mammals and any tuna that are associated with the school. Presently, neither the mechanisms nor the function of the close association of the yellowfin tuna with these schools of dolphins in the eastern tropical Pacific are clearly understood.

Studies of the behavior of dolphins while captive in a purse seine net were pursued during the chartered cruise of the commercial seiner MV *Elizabeth C. J.*, in October 1976 (Norris et al.[1]). Prior to this cruise, however, beginning in 1973, an intensive effort was made to develop net modifications and fishing techniques that would decrease the incidental killing of the mammals. Much of this effort was based upon general, to date unpublished, observations of captured dolphins and tuna made by National Marine Fisheries Service (NMFS) observers and technologists. One of the behavioral patterns of the spotted dolphin first noted by NMFS divers in 1973 and then recognized for its contribution to incidental mortality in 1975 is termed here "passive" behavior.

In the fall of 1975, NMFS chartered the purse seiner MV *Bold Contender* to carry on fishing gear dynamics research aimed at reducing incidental dolphin mortality. Part of this research included the evaluation of the use of a two-man inflatable raft as a dolphin rescue platform during and after the release procedure known as the "backdown" (Perrin 1969; Coe and Sousa 1972). A face mask and snorkel were worn by the person in the rescue raft to enable him to: 1) signal when tuna were approaching the release area during backdown, 2) keep track of sharks, particularly the oceanic whitetip shark, *Carcharinus longimanus*, both inside and outside of the net, 3) locate and release any stray dolphins and, 4) observe the dynamics of the net modification being tested during the cruise. Notes on the behavior of the captured dolphins during backdown were recorded after each of the 25 net sets in which the rescue raft was used. The underwater passive behavior of spotted dolphins was first noted in the eighth net set of the cruise and in 14 subsequent sets.

The passive behavior manifests itself in possibly two forms during the backdown release procedure. The first, which has been described as "rafting" by Norris et al. (see footnote 1), consists of groups of 5-50 or more spotted dolphins hanging tail-down at or near the surface and showing no overt reactions to their surroundings. This type of passive behavior can be seen from the deck of the seiner and is generally displayed from the time the net is pursed through the backdown (about ½ h). There is a steady increase in the number of rafting animals until backdown begins and then an apparent sharp decrease as backdown proceeds. The decrease in rafting may be due to the crowding and confusion during that period. Rafting behavior simplifies the effective release of these animals by backdown, because the net is actually pulled out from under the "raft" of dolphins as it remains relatively stationary in the water. Observations during the *Elizabeth C. J.* cruise showed that in every school of captured spotted dolphins some portion exhibited this behavior.

Dolphins in the captured school that are not in rafts during backdown are either actively swimming, usually in the horizontal plane directly away from the advancing wall of the net, or display the second manifestation of passive behavior. Prior to backdown, rafting dolphins are occasionally observed to sink tail first to depths up to 5 m before they swim awkwardly back to the surface, breathe, and sink again. During backdown, however, there are occasionally relatively large numbers of animals that sink to lie on the webbing (Figure 1) and many more that show signs of the sinking behavior and drop out of the rafts.

During backdowns on the *Elizabeth C. J.* cruise, from 3 to an estimated 75 spotted dolphins and, in one set, 2 bottlenose dolphins, *Tursiops truncatus*, were observed lying on the webbing in the bottom of the backdown channel. These animals, which

[1]Norris, K. S., W. E. Stuntz, and W. Rogers. 1978. The behavior of porpoises and tuna in the eastern tropical Pacific yellowfin tuna fishery - preliminary studies. Available U.S. Dep. Commer., Natl. Tech. Inf. Serv., Springfield, Va., as PB-283970, 86 p.

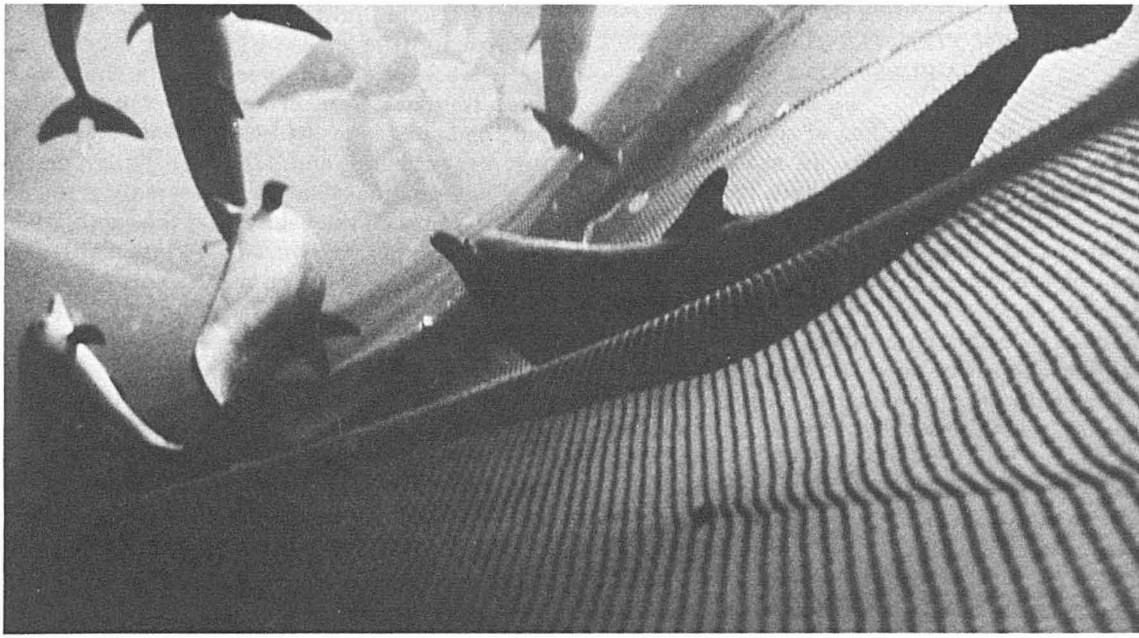

FIGURE 1.—Photograph taken during backdown of a tuna purse seiner showing three passive dolphins in the foreground. Note that the middle animal is resting on its dorsal fin. The four animals that are hanging flukes downward in the water are displaying the sinking behavior associated with rafting. (Photo courtesy of the Cooperative Dedicated Vessel Research Program, 1978.)

were making no apparent attempt to surface, were at depths that varied from 2 or 3 m to as much as 12 to 15 m. At first glance, the animals appeared to be struggling feebly, perhaps against the current being produced as the seine was pulled through the water during backdown. Their movements were weak and lacked the grace that long observation leads one to expect in dolphins. The majority of animals lying on the net in this manner were oriented with their heads toward the release area of the net (i.e., in the direction of the current), whereas the rafting and active animals were normally oriented away from the release area (i.e., heading into the current). After about 3-5 min, the passive dolphins began to rise singly or in two's and three's to breathe and were either backed out of the net or hand-released if the backdown procedure had already been terminated. No animals were seen returning to rest on the bottom of the net after surfacing.

Prior to promulgation and adoption of a federal regulation requiring use of a rescuer in a raft using a mask and snorkel, which resulted from the chartered cruise of the *Bold Contender*, this passive behavior probably was an important contributor to dolphin mortality in purse seines. When viewed from the deck of a speedboat tending the corkline in the dolphin-release area during backdown, these animals appeared to be dead if they were noticed at all, and as a result the release efforts were often prematurely terminated. Dolphins not released during the backdown have a high probability of being killed (Coe and DeBeer[2]).

The reasons for passive behavior in purse seine-caught spotted dolphins are not understood. The behavior has only rarely been observed in spinner dolphins in the tuna fishery. A similar behavior pattern has been described for two newly captured Hawaiian spinner dolphins during escape behavior experiments designed to delineate the dimensions of a dolphin release gate for possible use in purse seine nets (Perrin and Hunter 1972).

Animal trainers and biologists have noted what appears as similar behavior in individual captive dolphins of several species. Caldwell et al. (1966) reported prolonged inverted "resting or sleeping

[2]Coe, J. M., and J. DeBeer. 1977. Results of the 1976 twenty vessel test of two fine mesh systems to reduce incidental porpoise mortality in tuna purse seining. Unpubl. manuscr., 75 p. Southwest Fisheries Center, P.O. Box 271, La Jolla, CA 92038.

on the bottom of the tank" by a juvenile male Boutu, *Inia geoffrensis*. The occurrence of this behavior in *I. geoffrensis* and that observed in a juvenile male Atlantic bottlenose dolphin was frequent and apparently spontaneous (Caldwell[3]). Pryor[4] and Norris et al. (footnote 1) have noted instances where the passive-type behavior was presumably induced in training situations where *Tursiops* spp. were being "worked hard." These animals would go to the bottom of the tank, emit a quantity of air and might remain at the bottom for several minutes. Norris et al. hypothesized that this behavior may be similar to the "dearoused state" described by Delius (1970) for terrestrial animals, the most widely known example of which is the feigning of death by the Virginia opposum, *Didelphis marsupialis*. The major criticism (Norris et al.) of the dearousal hypothesis in the present situation would seem to concern the evolutionary value of such a response to a pelagic air breathing animal that would tend to sink toward the bottom in very deep water. One argument (Norris et al.) is that the situation which elicits dearousal (purse seining) has been a factor for only about 15-20 yr, and it is therefore not necessary to hypothesize an adaptive value for the behavior. To accept this hypothesis it would have to be assumed that the capability for dearousal has evolved in response to other circumstances.

A second hypothesis to explain this behavior relates to the effects of chase and capture on the physiology of the dolphins. Possibly indicative is the awkwardness of the swimming movements displayed by the animals while "passive." Harthoorn (1973) described the effects of chase and capture on large African mammals. Long chases using motor-driven vehicles result in a typical condition termed "capture myopathy." Capture myopathy is very common in the animals captured for zoos and often causes a delayed mortality. Symptoms include stiffness and awkward movements. The method of capturing dolphin schools involves a chase by speedboats that lasts up to 1.5 h and averages between 20 and 30 min. A chase of that duration is capable of causing myopathies in large terrestrial mammals which can be detected by measuring changes in blood serum enzyme levels (Harthoorn). A recent paper by Colgrove (1978) documents a suspected case of myopathy in a dolphin, *Tursiops gilli* = *T. truncatus*. This case of myopathy appears to have been induced by the stress of transporting the animal. Investigation of blood chemistry of passive dolphins may allow determination of whether capture myopathy does occur as a result of chase and capture during the tuna seining operation.

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[4]Karen Pryor, former head animal trainer, Sea Life Park, Hawaii; present address: 28 East 10th Street, New York, NY 10003, pers. commun. November 1976.

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