NOTES

MIGRANT GRAY WHALES WITH CALVES AND SEXUAL BEHAVIOR OF GRAY WHALES IN THE MONTEREY AREA OF CENTRAL CALIFORNIA, 1967-73

This paper presents evidence modifying two statements in the monographic study of the gray whale, *Eschrichtius robustus*, by Rice and Wolman (1971):

1. "The route taken by females with calves during the spring [northward] migration is unknown [page 14]." They arrived at this conclusion after being able to cite only three records of cows with calves over a 10-yr survey period inshore and offshore, at San Francisco and on aerial censuses from San Francisco, Calif., to Cape Flattery, Wash.
2. "Non-pregnant adult females regularly ovulate in late November and early December . . . while still north of central California on the southward migration [page 61]." and "Almost all of the adult females (except those carrying near-term fetuses) taken during southward migration [end of page 73] probably had already conceived, although none was visibly pregnant. . . . The mean conception date calculated from the fetal growth curve . . . is 5 December. . . . The calculated conception dates fall between 27 November and 13 December, except for one on 22 December and one on 5 January [pages 73-74]."

Whales with Calves on Northward Migration

The known breeding grounds of the northeastern Pacific Ocean population of gray whales were described in detail by Gilmore (1960). Rice and Wolman (1971) reviewed in their monograph the seasonal migratory cycle of this species. Leatherwood (1973)[1] reported 23 observations of northbound females with calves sighted during aerial censusing from 1969 to 1972, off southern California. The majority were "well inshore."

[1]Leatherwood, J. S. 1973. Aerial observations of migrating gray whales, *Eschrichtius robustus*, off southern California (1969-1972). California Gray Whale Workshop, 21-22 Aug. 1972. (Unpubl. manuscr.)

At 1400 h on 12 May 1967, at Point Lobos State Reserve near Carmel, Calif., a group of six or seven killer whales, *Orcinus orca*, attacked a gray whale and its 6-m calf, killing the latter as it took refuge in beds of giant kelp, *Macrocystis pyrifera*, (Baldridge, 1972). This was considered to be the same group of killer whales that unsuccessfully attacked two adult gray whales and a calf just outside the surf at Moss Landing, Monterey County on 2 May 1967 (Morejohn, 1968).

At 1350 h on 27 March 1970, at Lucia, Monterey County, 70 km south of Carmel, together with W. B. Gladfelter, I observed an adult and calf, with a second adult in close attendance. All were resting at the surface in open water on a day of remarkable calm. One adult frequently rolled on its side, raising a flipper and half of the tail flukes above the surface. The distance from the point of observation was too great to confirm whether or not the calf nursed. They remained in the same location for 30 min and were still there when observation was terminated.

From 0715 to 0800 h on 16 April 1970, two adults accompanied by their calves with an estimated length of 6-7 m remained in a sheltered cove at Hopkins Marine Station in Pacific Grove, Monterey County, where the water depth is 12 m. Both calves appeared to nurse when the adults rolled on their longitudinal axes, each with a flipper and half fluke raised. Although the calves were mottled in pigmentation, no barnacle incrustations could be seen on the dorsal areas. Upon completion of the nursing behavior the adults, very closely accompanied by their calves, swam off on a course following the shore of Monterey Bay. Northbound whales unaccompanied by calves for the most part follow a direct course from the vicinity of Point Pinos, Monterey County, toward Davenport, Santa Cruz County, 48 km to the north.

At 0900 h on 15 May 1971, at Julia Pfeiffer Burns State Park, 40 km south of Carmel, Judson E. Vandevere and I observed two adults, one very closely accompanied by a half-grown calf. They swam steadily north very close to, and in some instances through, the outer edges of the kelp beds.

At 1200 h on 3 May 1973, at Hopkins Marine Station in Pacific Grove, an adult and calf, closely attended by two more adults, the four in very close formation and almost touching, followed a course identical with that of the animals seen on 16 April 1970. They did not appear to stop and nurse although there was much splashing and rolling on their sides as they proceeded.

In addition to these observations, L. G. Ingles (1965:329) recorded an instance of nursing behavior observed "early one April a few miles south of Carmel." P. Sund of the National Marine Fisheries Service reported (pers. commun.) that on 23 January 1973, during aerial censusing of southbound gray whales, he observed an adult with a small nursing calf just north of Pt. Sur, Monterey County. This is the first instance which has come to the attention of this author, of a calf born north of San Diego, Calif.

Hubbs (1959) in describing the northwar migration off southern California stated "the cows with calves seem to take a more offshore path." With the possible exception of the 1970 record, my own observations suggest that females accompanied by calves keep very close to shore, often moving through the outer fringes of the extensive beds of giant kelps. In all of these observations the very close proximity of calves to females when swimming was apparent. J. S. Leatherwood (pers. commun.) indicated that his aerial observations showed the calves "all nearly touching the mother."

Sexual Behavior of Courting and Possibly of Mating Pairs and Trios

Published reports of sexual activity in gray whales outside the known calving areas in western Mexico were reviewed by Rice and Wolman (1971:97). They are of a fragmentary nature and include a single observation in Humboldt County in northern California (Houck, 1962) and several summer reports of courtship behavior and apparent copulation from the Bering Sea (Tomilin, 1937; Sauer, 1963; Fay, 1963). In addition, Gilmore (1960:12) stated that gray whales "occasionally calve and more often mate in waters off San Diego." The species bred in large numbers in San Diego Bay until the 1870's (Gilmore, 1960).

It would therefore seem worthwhile to indicate that such activity is not unknown in the Monterey Bay area of central California. It has been observed during both the southbound and the return migration (See Table 1).

In all cases the attention of the observer was first drawn to these whales by behavior unlike that of the normal activity of migrating whales. The whales remained in one particular place for long periods and frequently exposed flukes and flippers in a manner not typically seen in actively migrating individuals.

Because Sauer (1963) provides the only detailed published description of courtship behavior in this species, I have used the same terminology in the present account. After cessation of migratory swimming, the whales remained for the most part within a very small area, with one individual, thought to be the ♀, proceeding to swim almost imperceptibly, with an "exaggerated arching" (Sauer's phrase) out of the water of the back and caudal area. This was repeated several times, following which the ♂ appeared to maneuver to get beneath the ♀, by rolling on his side with one flipper and half of the fluke raised vertically above the water surface. After one or more attempts in this manner, the "♀ rolled around the longitudinal axis" (Sauer's phrase) and in apparent genital contact the whales proceeded to "swim in line" (Sauer's phrase) for periods of up to 30 s. In this position the left flipper of the ♂ and the right flipper of the ♀, together with the left half of the male's flukes and the right half of that of the female were raised above the surface as the two whales moved very slowly forward.

The ♀ in the initial stages, and prior to rolling around the longitudinal axis, often raised her head from the water at a 35° angle. The swimming in line sometimes began or ended with both animals apparently in genital contact vertically in the water column, both with their heads raised above the water surface and some 3—4 m apart.

The fact that this was copulatory behavior of considerable intensity was apparent from the erect penis of the male, which was clearly visible on many occasions. When the ♀ failed to roll on her side, the ♂ then appeared at the surface ventral side uppermost with penis erect in an approximate semicircle. Gilmore (1954) illustrates this posture. On one occasion (28 January 1971) while the ♂ swam in this way, the penis was seen to be extruded and withdrawn. The sequence of events leading to copulation was repeated as many as three times within a 2-h period.

It is of interest to note that on six of the eight occasions on which courtship behavior was observed, there were three whales involved. The

TABLE 1.—Sexual behavior, indicating date, water depth, locality, migration direction and remarks.

Date time water depth	Location[1]	Direction of migration	Remarks
27 Jan. 1968 1520–1720 h 18 m	300 m off Lover's Point, Pacific Grove	south	2 whales attempting copulation (see text for description).
27 Mar. 1970 1230–1300 h 40 m	850 m offshore at Lucia, 70 km south of Carmel	north	3 whales lay at the surface and rolled on their sides. Water surface much agitated and 2 animals seen to surface with heads vertically thrust from the water as far as the eye, in close enough contact to be attempting copulation. No penis observed. 0.5 km away another pair behaving similarly. Water exceptionally calm.
28 Jan. 1971 1445–1600 h 32 m	400 m off Hopkins Marine Station, Pacific Grove	south	3 whales made repeated attempts at copulation (see text for description).
3 Feb. 1971 0700–1200 h 30 m	400 m off Cannery Row, Monterey	south	2 whales repeatedly attempted copulation.
18 Mar. 1972 0925–1000 h 30 m	near Point Pinos, Pacific Grove	north	3 courting whales observed by Margot Nelson. Erect penis of ♂ clearly seen during attempted copulation.
21 Mar. 1972 1230–1430 h 40 m	400 m north of Point Pinos, Pacific Grove	north	3 courting whales. Still in progress when observation terminated (see text for description).
24 Mar. 1972 1700 h 40 m	1 km north of Lover's Point, Pacific Grove	north	3 courting whales observed. Too far off for details to be observed, although behavior pattern similar to that observed on other occasions.
4 Apr. 1972 1800–1830 h 20 m	Close to Point Pinos, Pacific Grove	north	3 courting whales. Behavior similar to that observed on other occasions, although no penis observed. For whole period of observation 3–4 California sea lions *Zalophus californianus* cavorted around the whale trio, about their heads, moving under and over the whales, often "porpoising." On occasion the sea lions would remain vertically in the water, heads down beneath the surface, presumably observing the whales, while their hind flippers protruded from the surface.

[1]All locations in Monterey County, Calif.

third whale was always in very close attendance and apparently in bodily contact with the pair attempting mating. Gilmore (1960:16; 1968:12) observed such trios in Mexican waters and speculated that the third whale was another ♂. "With half of the females unavailable each winter 'for mating', there are two eligible males for each female." He described the apparent lack of aggression between ♂♂, and this appeared to be so in the present observations. Walker (1971:403) believed the second male in such trios helps to stabilize the mating pair. More detailed aerial observation will be needed to clarify the role of the second male.

In comparing the Monterey observations with Sauer's detailed Bering Sea account, the following differences were noted:

1. His observations appear to have involved pairs rather than trios, although Fay (1963) reported three whales involved in "courtship play" some 30 km from the site of Sauer's observations.

2. Sauer does not mention seeing the penis displayed.

3. Sauer's animals repeatedly swam in circles 50–200 m in diameter. Such circling was not discernible in Monterey, where the activity took place in the open sea rather than within the confines of a small bay.

4. His description of the female initiating and achieving copulation (Sauer, 1963:166) by means of a "touch display" could not be verified in Monterey, where the observers' viewpoint was usually only 7–8 m above the water surface and the whales from 300 to 600 m distant. Sauer (1963:159) also described the whales as sensitive to his silhouette on the cliffs above and liable to break off courtship activity. This contrasts with behavior in Monterey, where courting pairs and trios were seen on three occasions to be approached by powered boats to within a few meters without apparent interruption of their activity. No "post-copulatory shake" was observed among the Monterey animals.

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NET FILTERING EFFICIENCY OF A 3-METER ISAACS-KIDD MIDWATER TRAWL

The errors associated with quantitative sampling of open ocean populations of zooplankton and epipelagic nekton have received considerable attention. Net selectivity, net sampling efficiency, and patchiness have been examined by Barkley (1964), Murphy and Clutter (1972), and Wiebe and Holland (1968), respectively. Studies of the error caused by avoidance have been summarized by Clutter and Anraku (1968) and further advanced by Barkley (1972). Aron and Collard (1969) have reported on the effects of net speed on catch. Extrusion of organisms through the net, the degree of mesh retention, and the effects of net clogging have been summarized by Vannucci (1968), and a review of filtration problems has been presented by Tranter and Smith (1968).

Somewhat less effort has been directed toward problems encountered in sampling the midwater fish fauna. Harrison (1967) reported on the reliability of trawl data, the bias that may result from using various types of gear, and the problems associated with sampling mesopelagic fishes. These fishes are commonly sampled with an Isaacs-Kidd Midwater Trawl (IKMT) (Isaacs and Kidd, 1953) and results of such sampling, which include considerations of net performance, have been reported by Pearcy and Laurs (1966), Gibbs et al. (1971), Friedl (1971), Backus (1972) Krueger and Bond (1972), and others.

Net performance is critically dependent on the filtering efficiency of the net. Filtering efficiency is a measure of the total volume of water filtered by the net and enables a better quantitative estimate to be made of the actual population density of organisms sampled. Pearcy and Laurs (1966) reported a filtering efficiency of 85% for a 2-m IKMT. To the authors' knowledge, no comparable figure has been published for the 3-m IKMT. This paper investigates the efficiency of this larger net.

Methods

In conjunction with studies of macroplankton and midwater fishes of an area off Bermuda called Ocean Acre (Brooks, 1972), experiments were conducted in January 1973 to determine the net filtering efficiency of a 3-m IKMT.