Anales Inst. Biol. Univ. Nac. Autón. México, Ser. Zoòl. 62(2): 263-268, 1991

# GEOGRAPHIC AND SEASONAL DISTRIBUTION OF THE VAQUITA, *PHOCOENA SINUS*

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**RESUMEN**

Se hicieron recorridos aéreos por 980 km para buscar a la vaquita, *Phocoena sinus,* en el norte del Golfo de California durante septiembre de 1989. Además, fueron colectados cuatro ejemplares completos de vaquita en 1987 y 1988. Las vaquitas fueron vistas desde el avión en siete ocasiones (14 individuos). El tamaño promedio de sus grupos fué de 2.0 individuos y todos los registros fueron en aguas profundas desde 20 a 56 m.
Nuestras observaciones de otoño sobre la abundancia relativa, tamaño de grupo, y aguas profundas utilizadas por la vaquita fueron similares a las de primavera. Nuestros resultados de otoño (cuando se presenta la temperatura máxima en la superficie del mar) sugieren que la vaquita ocupa el norte del Golfo todo el año y que la especie tiene adapataciones que le permiten soportar amplios intervalos de temperaturas en el norte del Golfo.

Palabras clave: marsopa, Golfo de California, *Phocoena sinus,* censos aéreos.

**ABSTRACT**

A total of 980 km of aerial surveys were flown in search of the vaquita, *Phocoena sinus* in the northern Gulf of California in September 1989. In addition, four whole vaquita specimens were collected in 1987 and 1988. Vaquita were seen from the aircraft on seven occasions (14 individuals). Mean group size was 2.0 individuals, and all sightings occurred in water depths that ranged from 20 to 56 m. Our observations on the relative abundance, group size, and water depths utilized by the vaquita obtained during fall surveys were similar to those previously obtained in spring surveys. Our sightings obtained in fall (when sea surface temperature maxima occur) suggest vaquita occupy the northern Gulf year-round, and the species exhibits adaptations that enable it to withstand great water temperature ranges in the northern Gulf.

Key words: porpoise, Gulf of California, *Phocoena sinus,* aerial surveys.

## INTRODUCTION

The range of the rarely encountered porpoise *Phocoena sinus* (common name: vaquita), may be limited to the northern Gulf of California (Norris and McFarland, 1958; Villa-R., 1976; Brownell, 1983, 1986). Within the northern Gulf, vaquita distribution appears to be further restricted to the areas in the vicinity of El Golfo de Santa Clara (Sonora), San Felipe (Baja California Norte), and south along the Baja

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California peninsula to Puertecitos. To date, most of the beach-cast specimens and osteological material have been recovered in the vicinity of San Felipe and near El Golfo de Santa Clara (summarized by Magatagan *et al.,* 1984; Brownell, 1986). In addition, nearly all sightings of the species in the northern Gulf (Wells *et al.,* 1981; Vidal *et al.,* 1985; Silber, 1988, 1990) have been made in a very restricted area; the waters between San Felipe and the island of Rocas Consag. Relatively few specimens have been recovered and virtually no sightings have been made near Puerto Peñasco and south along the Sonoran coast.

We describe additional sightings and specimens that support earlier contentions that *P. sinus* distribution is highly localized within the northern Gulf of California.

## MATERIALS AND METHODS

***Aerial Surveys.*** Surveys were conducted from a Cessna 205 single engine aircraft at an altitude of 152 m. A total of 980 km was searched on 2, 4 and 5 September 1989 (Fig. 1). Searches were conducted in the vicinity of Rocas Consag, near the Sonora coast, and along the Baja California Norte coastline south to 29° 55' N latitude.

When marine mammals were sighted we circled the location to confirm species identity and to obtain information on group size and behavior. It was generally difficult to re-sight *P. sinus* after the first sighting or to circle them for any length of time. The limited time during which the vaquita could be observed or re-sighted from the animal's small group size and body size and its erratic surfacing mode. The water depth at sighting locations was determined later from a nautical chart.

## RESULTS

***Sightings - September 1989.*** *Phocoena sinus* was seen on seven occasions (14 individuals) (Table 1), at a rate of 0.7 porpoises/100 km surveyed. Sightings occurred only in the western half of the northern Gulf, roughly between San Felipe and the island of Rocas Consag (Fig. 1). Porpoises were not seen south of Puertecitos, Baja California Norte or near the Sonoran coast.

Vaquita mean group size was 2.0 individuals and ranged from 1-3 (Table 1). All sightings occurred in water depths that ranged from 20 to 56 m and the mean water depth was 33.4 m.

***Specimens.*** Four whole specimens were collected that were ultimately deposited in osteological collections at the Universidad Nacional Autónoma de México (UNAM) or at the Center for the Study of Deserts and Oceans (CEDO), Puerto Peñasco, Sonora. One carcass was obtained in 1987 and three were collected in 1988 (Table 2). Two specimens were obtained near El Golfo de Santa Clara, one from San Felipe, and one was found on the beach near CEDO. Two specimens that had died in gillnets only hours or days prior to collection were provided by fishermen.

## DISCUSSION

Information from various sources suggests that 1) the center of vaquita abundance is in the northern Gulf of California, and the species could possibly be restricted to that area (Brownell, 1986), and 2) within the northern Gulf, sightings

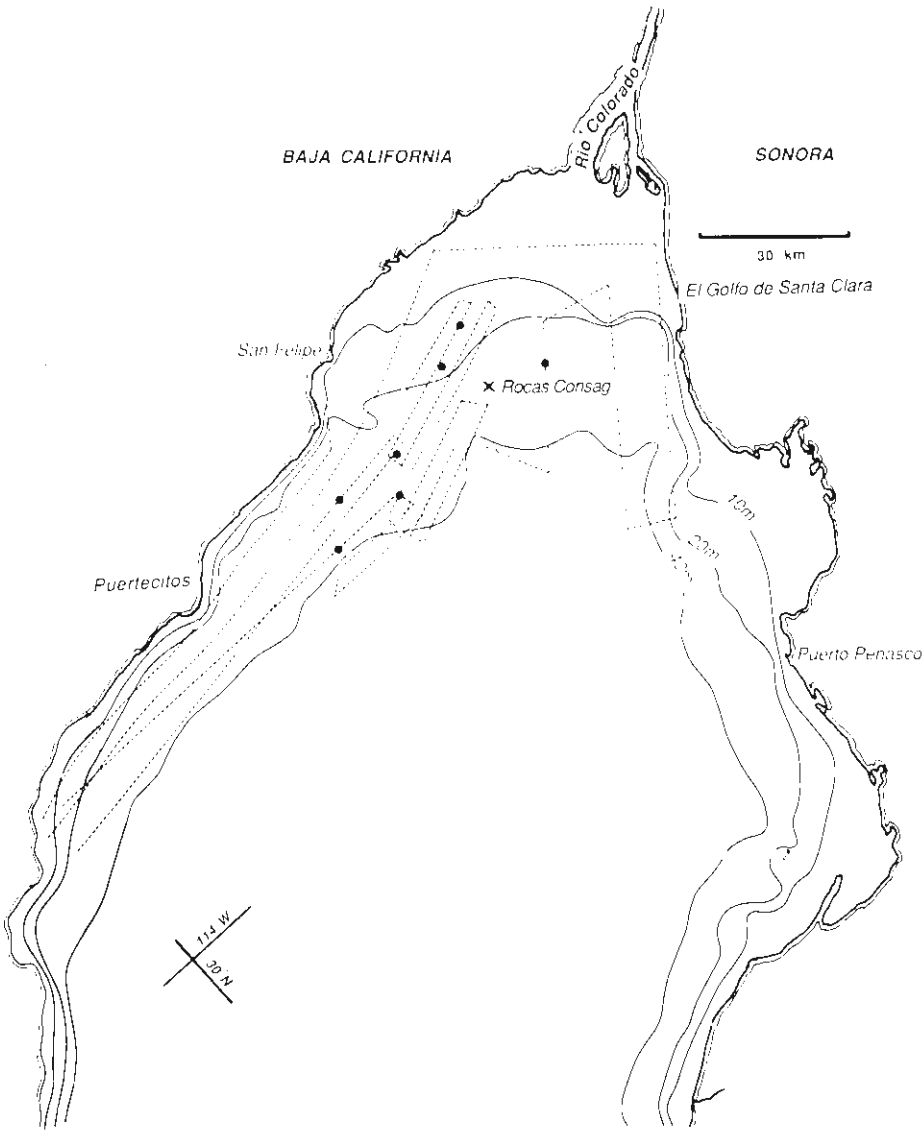


Fig. 1 Northern Gulf of California.

TABLE 1
*PHOCOENA SINUS* SIGHTED DURING AERIAL SURVEYS IN SEPTEMBER 1989

| *Date* | *Time* | *#Seen* | *Depth (m)* | *Distance to shore (km)* |
|---|---|---|---|---|
| September | | | | |
| 4 | 0836 | 3 | 28 | 17 |
| 4 | 0924 | 1 | 24 | 22 |
| 4 | 0935 | 3 | 20 | 18 |
| 4 | 1529 | 2 | 26 | 24 |
| 5 | 0931 | 2 | 56 | 22 |
| 5 | 0951 | 1 | 42 | 19 |
| 5 | 1221 | 2 | 38 | 14 |
| | mean = | 2.0 | 33.4 | 19.4 |
| | sd = | 0.82 | 12.63 | 3.46 |
| | total = | 14 | | |
| | n = | 7 | | |

TABLE 2
*PHOCOENA SINUS* SPECIMENS RECOVERED DURING FIELD WORK, 1986-1988

| *Specimen No.* | *Date collected* | *Locality* | *Sex* | *Size (cm)* | *Deposition location* | *Gillnet victim (Y/N)* | *Comments* |
|---|---|---|---|---|---|---|---|
| 1 | 30 April 1987 | Puerto Peñasco | M | 145.0 | CEDO* | ? | decomposed |
| 2 | 5 April 1988 | El Golfo de Santa Clara | F | 72.0 | UNAM** | Y | from fishermen |
| 3 | 11 April 1988 | San Felipe | M | 129.0 | UNAM | Y | from fishermen |
| 4 | 21 April 1988 | El Golfo de Santa Clara | ? | --- | UNAM | ? | decomposed |

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(but not strandings) are narrowly distributed, favoring the western perimeter of the northern Gulf (Silber, 1988, 1990). Data presented here are in agreement with previous observations, and in addition, we have shown that the species is present in the northern Gulf in early fall, suggesting that utilization of the region is a year-round feature.

Although numerous sightings have occurred in the northern Gulf (Wells *et al.*, 1981; Vidal *et al.*, 1985; Silber, 1988, 1990), relatively few sightings have been reported in areas outside this region (Norris and McFarland, 1958; Norris and Prescott, 1961; Villa, 1976; Silber, 1990). No specimens have been collected outside the northern Gulf (Brownell, 1986). These observations may indicate the possibility of a greater historical range, but relative abundance is clearly greatest in the northern Gulf.

It is worth noting that while sightings of the closely related *Phocoena phocoena* at its southern range limit in California are also restricted to a modest number of

localities, the southernmost being Monterey Bay. The range of this species as determined by occasional captures or strandings, extends far to the south of this locality. For example, althought the southernmost locality where sightings of *Phocoena* schools regularly occur is Monterrey, Bay, specimens have been taken from San Pedro, California (Norris and McFarland, 1958), and sightings have been made as far south as Long Beach California (K. S. Norris, pers. obs.). Apparently the species, always secretive, may move in small numbers far beyond its centers of abundance.

Phocoenids are antitropical in distribution (Norris and McFarland, 1958; Barnes, 1985) and they generally inhabit cold-water areas (Gaskin, 1982). If *P. sinus* occupies the northern Gulf of California all year as our records suggest, it must be subjected to very high water temperatures during summer and fall (to 32°C; Álvarez-Borrego, 1983). If its body temperature is like that of other mammals (near 37°C), very little difference exists during such high temperature periods between its body temperature and its environment, presenting the animal with severe heat balance problems during activity. This circumstance is probably related to the unusual size of the dorsal fin, pectoral flippers, and tail flukes in vaquita. The extremities of this species are large relative to its mass, and they represent important heat exchange surfaces. In addition, *P. sinus* is smaller in body size that all of the phocoenids, and nearly all of the delphinids. Worthy and Edwards (1990) proposed that a small body size, and therefore reduced surface area/body mass ratio, is an important feature in phocoenid thermoregulation, and vaquita may have evolved a small body size in response to heat stress. Furthermore, the blubber layer of harbor porpoises, *P. phocoena,* has certain physical and biochemical features that are related to heat balance (Worthy and Edwards, 1990), and vaquita may also have a blubber composition that facilitates thermoregulation.

In addition to a restricted central range, vaquita distribution in the northern Gulf appears to be highly localized (Silber, 1990). Densities are apparently highest near the Baja California peninsula, and they remain relatively high in the area that extends from Rocas Consag toward the coast southeast of El Golfo de Santa Clara. Of the 45 records of the vaquita summarized by Brownell (1986), 41 occurred either in San Felipe or El Golfo de Santa Clara, including the type specimen (Norris and McFarland, 1958). Our specimen localities are consistent with those previously reported (Norris and McFarland, 1958; Orr, 1969; Noble and Fraser, 1971; Magatagan *et al.,* 1984; Brownell, 1986). Sightings obtained during boat and aircraft surveys conducted between 1986 and 1989 showed a similar distribution. They occurred primarily within 40 km of San Felipe (Silber, 1988, 1990).

Much of the previous survey effort and all of the sightings in the northern Gulf (Wells *et al.,* 1981; Vidal *et al.,* 1985; Silber, 1988, 1990) occurred in spring months. Our sightings obtained in fall suggest year-round occupancy of the northern Gulf. In addition, observations on the relative abundance, group size, and water depth utilization by the vaquita obtained during fall surveys are similar to those obtained in spring surveys (Wells *et al.,* 1981; Vidal *et al.,* 1987; Silber, 1988, 1990), which suggests that these features are year-round phenomena.

The numbers of vaquita sighted in the northern Gulf are nonetheless low, and there is clear cause for concern with regard to the preservation of the species. A

shrinking population, resulting at least in part from continued incidental mortality in gillnets (Turk Boyer, 1989), may have receded to the northern Gulf.

**ACKNOWLEDGEMENTS**

We thank Project Lighthawk and pilot Jerry Hoogerwerf for providing the opportunity to make survey flights. We are grateful to the Homeland Foundation for providing financial support, and to M. Newcomer and H. Pérez-Cortés for assisting in the aircraft surveys and in other aspects of the field work. The study was conducted under Scientific Research Permit numbers 301856, 300422, 400036 issued by the Secretaría de Pesca, Mexico. We thank Dr. F. Cervantes and an anonymous reviewer whose comments improved the paper.

**LITERATURE CITED**

ÁLVAREZ-BORREGO, S. 1983. Gulf of California. *In:* B. H. Ketchum (ed.) *Estuaries and Enclosed Seas. Elsevier, New York.* pp. 427-449.

BARNES, L. C., 1985. Evolution, taxonomy and antitropical distributions of the porpoises (Phocoenidae, Mammalia). *Marine Mammal Science 1:* 149-165.

BROWNELL, R. L., JR. 1983. *Phocoena sinus. Mammalian Species. 198:* 1-3.

———— ,1986. Distribution of the vaquita, *Phocoena sinus,* in Mexican waters. *Marine Mammal Science 2:* 299-305.

GASKIN, D. E. 1982. *The ecology of whales and dolphins.* Heineman, London. 459 p.

MAGATAGAN, M. D., E. H. BOYER AND B. VILLA-RAMIREZ. 1984. Revisión del estado que guarda *Phocoena sinus* Norris and McFarland y descripción de tres nuevos ejemplares. *Anales Inst. Biol. Univ. Nac. Autón. México, Ser. Zool. 55*(1): 271-294.

NOBLE, B. A. AND F. C. FRASER, 1971. Description of a skeleton and supplementary notes on the skull of a rare porpoise *Phocoena sinus* Norris & McFarland, 1958. *J. Nat. Hist. London 5:* 447-464.

NORRIS, K. S. AND W. M. MCFARLAND, 1958. A new harbor porpoise of the genus *Phocoena* from the Gulf of California. *J. Mamm. 39:* 22-39.

NORRIS, K. S. AND J. H. PRESCOTT. 1961. Observations on Pacific cetaceans of Californian and Mexican waters. *Univ.* California *Publ. Zool. 63:* 291-402.

ORR, R. T., 1969. An additional record of *Phocoena sinus. J. Mamm. 50:* 384.

SILBER, G. K. 1988. Recent sightings of the Gulf of California harbor porpoise, *Phocoena sinus. J. Mamm. 69:* 430-433.

———— , 1990. Occurrence and distribution of the vaquita, *(Phocoena sinus)* in the northern Gulf of California. *Fish. Bull.* U.S. 88: 339-422.

TURK BOYER, P. J. 1989. *Assessment of the potential impact of fishing activities in the northern Gulf of California on the Phocoena sinus population.* Report to the Center for Marine Conservation, Washington, D. C. 14 p.

VIDAL, O., A. AGUAYO, L. FINDLEY, A. ROBLES, L. BOURILLON, I. VOMEND, P. TURK, K. GARETE, L. MARONAS AND J. ROSAS. 1985. Avistamientos de mamíferos marinos durante el crucero "Guaymas I" en la región superior del Golfo de California, primavera de 1984. (Abstract) *X Reunión Internacional para el Estudio de los Mamíferos Marinos, 24-27 de marzo de 1985, La Paz, Baja California Sur, México.*

VILLA-R. B. 1976. Report on the status of *Phocaena sinus,* Norris and McFarland 1958, in the Gulf of California. *Anales Inst. Biol. Univ. Nac. Autón. México. Ser. Zool. 47*(2): 203-208.

WELLS, R. S., B. G. WURSIG AND K. S. NORRIS. 1981. *A survey of the marine mammals of the northern Gulf of California, Mexico, with an assessment of the status of Phocoena sinus. NTS PB* 81-168792, 51 p.

WORTHY, G. A. J. AND E. F. EDWARDS. 1990. Morphometric and biochemical factors affecting heat loss in small temperate cetacean *(Phocoena phocoena)* and a small tropical cetacean *(Stenella attenuata). Physiol. Zool. 63:* 432-442.