Dugong dugon. By Sandra L. Husar

Published 6 January 1978 by The American Society of Mammalogists

Dugong Lacépède, 1799

Dugong Lacépède, 1799:17. Type species Dugong indicus Lacépède, by original designation.

Platystomus Fischer, 1803:353. Type species Platystomus dugong Gmelin, by original designation [= T. dugon Müller].

Dugongus Tiedemann, 1808:554. Emendation (Latinization of Dugong).

Halicore Illiger, 1811:140. Type species Trichechus dugong Gmelin, by original designation [= T. dugon Müller].

Dugongidus Gray, 1821:309. Type species Trichechus dugon Müller, by original designation.

CONCEPT AND CONTENT. Order Sirenia. Family Dugongidae. Subfamily Dugonginae. The genus Dugong now includes only one species Dugong dugon as treated below.

Dugong dugon (Müller, 1776)

Dugong

Trichechus dugon Müller, 1776. Type locality Cape of Good Hope to the Philippines.

Trichechus dugong Erxleben, 1777:599. Type locality Indian Ocean.

Dugong indicus Lacépède, 1799. Type locality Indian Ocean.

Halicore hampichii Ehrenberg, 1832. Type locality Barkan Island, Red Sea.

Halicore lottum Ehrenberg, 1832. Type locality Hauakal Island, northern part of Red Sea.

Halicore tabernaculi Rüppell, 1834:113. Type locality Red Sea.

Halicore australis Owen, 1847:328. Type locality Endeavor Strait, Cape York, Australia.

Halicore cetacea Heuglin, 1877:135. Type locality Red Sea.

DIAGNOSIS. Because the genus is monotypic, the following diagnosis applies to genus and species: body fusiform; hind limbs absent; tail a deeply notched fluke; forelimbs paddlelike and without nails; skin smooth; muzzle directed ventrally, terminating in a horseshoe-shaped disc (about 17 by 23 cm in adults); complete dental formula 2/3, c 0/1, p 3/3, m 3/3, total 36, but the inner pair of upper incisors and all lower incisors and canines are vestigial (Mitchell, 1973; Lyman, 1939)—see Figure 1.

GENERAL CHARACTERS. Total length of adults is 2.4 to 4.06 m, corresponding weights are 230 to 908 kg (Heinsohn, 1972; Mani, 1960). The young are pale cream, and they darken with maturity to deep slate gray dorsally and laterally, slightly paler ventrally (Jones, 1960). Hair is short and sparsely distributed (30 to 50 mm apart) over the body except for dense bristles on the muzzle (Dexler and Freund, 1966b). The two mammae are axil-

Figure 1. Drawings of several views of a dugong and its skeleton (from Kingdon, 1971, by permission of the author, who drew the illustrations also).
lary. Nostrils are crescent shaped, approximately 18 mm in diameter and 16 mm apart, on the summit of the head and are closed by muscular valves (Hill, 1945). Eyes are small, round, and black; eyelids have no lashes and close with a sphincter action. The ear opening is 3 mm in diameter and has no external pinna. Bones are extremely dense. The premaxilla is sharply downturned; nasal bones are absent. The molariform teeth replace each other from the rear. The outer pair of tusks like upper incisors are larger in males than in females. Norris (1960), after measuring 33 dugongs from Ceylon, all over 1.83 m in length, concluded that females grow larger than males. Heinsohn (1972), however, examined 69 individuals from Australia, ranging from 1.09 to 3.05 m, and found no significant sexual difference in size. Similarly, when only sexually mature (2.4 m in length or longer) animals were considered, there was no sexual dimorphism.

Detailed descriptions appear in Gohar (1957), Hill (1945), Dexter and Freund (1906), and Owen (1838). Black and white photographs of the dugong head are shown in Dexter and Freund (1906) and anatomical drawings are included in Hill (1945).

**DISTRIBUTION.** The range of *D. dugon* (see figure 2) includes coastal waters within tropical and subtropical latitudes of the Indian and Pacific oceans. In Africa, the southernmost dugong record is a specimen that washed into Durban, South Africa, in 1966 (Best, 1968). The range extends northward along the coast to Egypt in the Red Sea (Stoddart, 1972; Gohar, 1967), but this distribution is not continuous. Populations are found in isolated channels and bays, and some local herds are known to have been extirpated. Dugongs were abundant off the shores of Madagascar in the early part of this century (Prater, 1929a), but few remain today (Philip and Fisher, 1970). Large herds in the Mascarene Islands were reported by Blyth (1859) to have been exterminated by the time of his writing. Substantial dugong concentrations exist in the vicinity of Antonio Enes, Mozambique (Hughes and Oxley-Oxland, 1971), and stable populations occur in the Rama-Zambar Channel and off the Bufigi-Mafia Islands of Tanzania (Kingdon, 1971; Dollman, 1933). Dugongs are more abundant in Kenya and the Somali Republic than elsewhere along the coast of Africa (Philip and Fisher, 1970), with the Kiunga Archipelago and the Lamu Island Sea supporting the major populations (Kingdon, 1971; Jarman, 1966). Kipini and Malindi, Kenya, also have persistent populations (Jarman, 1966). In the Republic of Somalia, dugongs are still found in Ras Bur Gao and along the archipelago to Kismayu, on the equator (Travis, 1967; Jarman, 1966). In general, dugongs seem to be less endangered along the east coast of Africa than in most other parts of their range (Fitter, 1969). Dugongs are now extremely rare in the Gulf of Aqaba, the Red Sea, and the Gulf of Suez (Bertram and Bertram, 1966, 1967, 1973; Norris, 1960; Gohar, 1957), and they are reportedly extinct in the Laccadive and Maldives islands (Snow, 1970).

The northernmost occurrence in India appears to be in the Gulf of Cutch (Lal Mohan, 1963; Jones, 1960), and further south dugongs have been extirpated from the entire Malabar Coast (Jones, 1967a) as well as from the southwestern coast of Ceylon (Deraniyagala, 1965). On the east coast of India, dugongs occur from south of Madras to Cape Comorin (Jonklaas, 1960). Overall, dugong abundance in Indian and Ceylonese waters is drastically reduced, and this scarcity is attributable to the increased marine fishery in the area (Bertram and Bertram, 1970a, 1970b).

The Nicobar, Barren, Narcondom, Coco, and Christmas Islands (a no longer support dugongs, although a few remain in the Andamans (Snow, 1970). Small numbers are found in Burma, the Mergui Archipelago, and Malaysia (Gibson-Hill, 1950), and dugongs have been completely hunted out of Borneo and the Philippines (Philip and Fisher, 1970; Wycherly, 1969). Specimens have been recorded from Hong Kong (Bertram and Bertram, 1973), Formosa (Hiratsuka, 1952), and the Ryu Kyu Archipelago (Hiratsuka, 1932), but dugongs are presently rare in these areas (Bertram and Bertram, 1973). The range extends east and south to include the Palau Islands (Harry, 1956), the Carolines, the Solomons, New Caledonia, New Guinea, New Hebrides, and Australia (Bertram and Bertram, 1973; Philip and Fisher, 1970; Jones, 1967a). According to Rice and Schefler (1968), dugongs are not present in the Marshall Islands (Philip and Fisher, 1970), or in the Gilbert, Eilie or Fiji islands (Bertram and Bertram, 1973).

The greatest concentrations of dugongs appear in northern Australian waters (Bertram and Bertram, 1973; G. Heinsohn, personal communication).

Along the west coast of Australia, dugongs range as far south as Perth (32°S) (Bertram and Bertram, 1966a), and stable populations have been reported for both Shark's Bay and Broome, Western Australia (Macmillan, 1955; G. Heinsohn, personal communication). The shores of the Northern Territory and Queensland support stable dugong concentrations, and dugongs are common in the Gulf of Carpentaria (Bertram and Bertram, 1973; G. Heinsohn, personal communication). Stocks seem to be maintaining themselves and even may be increasing in northeast Queensland (G. Heinsohn, personal communication). Formerly, dugongs occurred along the eastern coast as far south as Sydney; however, Brisbane is now the southern limit of their known range (Macmillan, 1955; MacInnes, 1951).

**FOSSIL RECORD.** The fossil history of the Dugongidae is extensive, beginning with terrestrial behive ancestors present during the early Eocene (Reinhart, 1971). Although their place of origin is unknown, dugongids were at one time world-wide in
distribution and their geographic history involves numerous complex migrations (Simpson, 1932). Earliest known fossils include *Prorastrum* of the Eocene of Jamaica (Owen, 1853), *Thalattostern* and *Sirenus* from the European mid-Eocene (Romer, 1966), *Prostern* from both Europe and North Africa in the middle Eocene (Romer, 1966). *Eoatheroides* from the middle-late Eocene of Egypt (Deperet and Roman, 1920; Palmer, 1899), and *Protherium* of the European late Eocene (Romer, 1966). *Lophiodontus* of South America, *Anomoitherium* of eastern Asia (Romer, 1966), and *Caribosiren* of Puerto Rico all date back to the Oligocene (Reinhart, 1959), and *Rystiodus* remains have been unearthed from late Oligocene deposits of Europe (Romer, 1966).

Miocene dugongids are *Probalicore* from Europe, *Indostern* from the East Indies (Romer, 1966), and *Hesperostern* from the east coast of North America (Simpson, 1932). *Halitherium* was especially widespread during the Oligocene and the early Miocene (Sickenberg, 1934; Deperet and Roman, 1920); fossils have been discovered over a vast range including Europe (Astré, 1954; Sickenberg, 1934; Lydekker, 1892; Hartlaub, 1886; Adams, 1866), the eastern United States (Kellogg, 1966; Simpson, 1932; Hay, 1922), and the western United States (Kilmer, 1965; Reinhart, 1959). Also present during the Miocene was *Halitherium* found in Europe (Romer, 1966), western North America (Kilmer, 1965; Reinhart, 1959) and eastern North America (Kellogg, 1966; Hay, 1922). Pliocene representatives are *Monastern* from Europe and *Felsinotherium* of North Africa, North America, and Europe (Romer, 1966).

**Figure 3.** Photographs of dorsal (top), ventral, and lateral (bottom) views of skull of a dugong (USNM 396962).

**Figure 4.** Photographs of lateral view of skull and articulated mandible of dugong (top) and anterior view of skull (USNM 396962).

*granulosum* of more flattened cells, *stratum lucidum* hardly distinguishable, *stratum corneum* only a few layers of flattened cells, *cutis vera* intensely white, constituting the major thickness of the skin, *corium* merging into the *panniculus adiposus* (blubber), which was not as abundant as in whales. Large amounts of fat were present in the omentum. Numerous cuts and scars are usually present, resulting from encounters with reefs, oyster beds, or other sharp objects. The short, fragile, unpigmented hairs are more numerous on the back than on the belly; few are present on the flippers (Dexler and Freund, 1906). Bristles cover the flattened mouth plate, formed by the upper lip; long, coarse, backwardly directed bristles project on both sides of the fibrous knob in the center of the upper lip; these interface with similar bristles on the lower lip. Detailed descriptions of hair, spines, and palatal plates are in Gohar (1957).

The skeleton is of extremely dense (pachyostotic) bone. Cranial characters (see figures 3 and 4) are: remarkably enlarged and sharply down-turned premaxilla, nasal basin on the top of the skull extending posteriorly beyond the anterior margin of the orbits, nasal bones absent, zygomeric arches thick and deep, braincase small. Molariform teeth (five or six per jaw) are replaced from the rear by newly erupting teeth. The anterivertmost teeth are partially resorbed and lost. Teeth are of cementum and orthodontine, lacking enamel (Flower and Lydekker, 1891). Cheekteeth increase in size from front to rear and except for the last, which is grooved laterally, they are suberetere in cross section; roots are simple and open. The inner pair of upper incisors, thought to be deciduous by Heuvelmans (1941), is resorbed early; the outer pair (tusks) protrude into the mouths of males and some females (G. Heussohn, personal communication). Eight prominent alveoli (four per jaw) containing vestigial teeth are located in the anterior face of the

**FORM.** The following description of dugong skin is from Gohar (1957). In a 288-cm female, the epidermis was only 2.5 mm thick on the belly. The skin, 35 mm thick on the dorsum and only 25 mm thick on the venter, was characterized as follows: *rete mucosum* with a well-developed layer of columnar cells, *stratum
mandible (Lyman, 1939). Further discussion of tooth succession and possible sexual dimorphism in skulls is in Mitchell (1975). Sex has provided the possibility for determining the number of growth layers in the dagonous tooth. Vertebral column 57 to 60 (cervical), 17 to thoracic, 4 lumbar, 3 sacral, 28 to 29 caudal. Ribs are slender and the sternum is reduced; the scapula has developed but the cornacoid is well developed; and the ilium is absent. The humerus has prominent tuberosities and carpals show a tendency for fusion (Harrison and King, 1965). The pelvic girdle is vestigial. Pubic bones are absent and the illium and ischium are rodlike (Jones and Johnson, 1967).

The body muscle is dark red and consists mostly of primitive "red" muscle. The heart is large; the large, globular heart has a large interventricular cleft (Harrison and King, 1965); ventricles are divided almost to their roots on the auriculoventricular fibrous rings (Hill, 1945). Further descriptions of the heart and major blood vessels (Hill, 1945) are of an an arterial plexus (not a rete mirabile), thought to aid in thermal regulation with an estimated maximum change in blood flow of 30-fold (Eklund et al., in Lenfant, 1969).

The small brain, weighing 282 g in a 300 kg female (Dexer, 1912a), is characterized by few and shallow sulci on the frontal, parietal, and temporal lobes. Corpus quadrigemina are prominent and the fornix is less well developed. See Drexler (1912b) for a detailed description of the brain, and see Dexter (1912b) for an account of the spinal cord. Eye sockets are especially large; the malleus is ankylosed to the tympanal; the processus hookins is joined to the tegmen tympanum (Robineau, 1965).

This anchoring apparently damps all osseous vibration (Fitch, 1950). Thick epiglottis is completely separated from the larynx; glos- gottis; thyroid, cricoid and arytenoid cartilages are present (Hill, 1945); vocal cords are absent, but cushionlike protuberances in the larynx may serve the same function (Harrison and King, 1965). A single, four cartilage ring is deeply divided by a medial septum (Harrison and King, 1965; Hill, 1945). Dorsoventrally flattened lungs extend posteriorly to the kidneys (Hill, 1945). The lungs differ histologically from those of all other mammals (Engel, 1962); unique vesicles (unlike typical alveoli) arise later- ally along the bronchiol and are the sole respiratory units (Engel, 1959); bronchioli are unusually muscular (Engel, 1962), possibly functioning long after birth (Dexter, 1928). Here, the lung is capable of enlarging the dagonous to the extent that it can be used for breathing only with the aid of flippers or tail, or the expelling of air. The short tongue (about 14 cm in an adult) is anteriorly truncate, and has little mobile skin. It is covered with large filiform papil- lae and clustered retroverted cuticular spines (Sohar, 1957; Sonntag, 1922); numerous taste buds in cup-shaped cavities are located on the rear of the tongue (Gudernatsch, 1967). Large parotid glands are the only salivary glands; tonsils are absent (Hill, 1945). The stomach is simple in form; cardiac and pyloric regions of the gastric mucosa are evident; detailed descriptions of the stomach and caecum and Amdoual may be found (Hill, 1945; and Owen, 1828). The stomach is thick-walled and has two pyloric caeca; the large intestine is thin-walled and has a single colon. Colon and hindgut are not divided individually; a single conical caecum projects from the colon. Just inside the anal margin are 12 globular swellings that may act as anal valves (Hill, 1945). The four-lobe liver is flattened against the sternum. Liver is positioned anterior; both the gall bladder and pancreas are small, but the common bile duct (6 mm in diameter) is long (Hill, 1945). A biochemical analysis of the bile is in Caldwell et al. (1969).

Smoothly rounded kidneys are elongate, neither reniform nor lobulate. They are unique in being dipelvic and in having numerous regions of the fibrous network without epithelial covering (Battrawi, 1953, 1957); the arrangement of the renal pyramids suggests a retailed segmental structure. The bladder is small; its wall is thick and muscular (Hill, 1945). Abdominal testes bade caudal to the kidneys; within pleural and subcostal glands, and the prosthetic utricule are absent (Harrison, 1969). Ovular ovaries (about 34 by 17 mm) are enclosed within a peritoneal pock (Hill, 1945); ovarium embryology is not studied. The long, thin-walled vagina has a keratinized sheath arising in the vulval region and this shield, sur- rounding the cervix, extends along the ventral wall of the vagina (Harrison, 1969); each uterine cornus measures about 167 mm in length. Detailed descriptions of the reproductive organs are found in Harrison (1969). The placenta has been described as diffuse at first, becoming zonary later in development (Dexter, 1899), but Harrison (1969) suggests that examination of the placenta of "Oklo's" (Wissler's 1935) findings on the manatee placenta, which is zonary and hemochro- mous.

Ventral to the trachea and posterior to the larynx is the small (5.7 g in an adult) thyroid gland (Hill, 1945). The unusually dense and compact stroma may cause hypothyroidism resulting in partial cretinism and Amdoual (Lyman, 1967). The thyroid gland is extremely lobulated; macroscopic examination revealed no parathyroids (Cave and Aumonier, 1967). Small, triangular ad-
MAMMALIAN SPECIES 88

preponderance of females in Indian coastal waters and sexual partitioning of the habitat has been suggested as a likely explanation (personal communication). Heimsoth has presented data on age composition. A high proportion of young animals was found in the population sampled, but results may have reflected the population decimation that occurred during the precontact period. The tropical or subtropical dugong does not appear to select any particular salinity, and although not known to ascend rivers, dugongs have been found in brackish waters (Kingdon, 1967; Ganskopp, 1967). Optimal dugong habitat is characterized by: 1) saline waters to 2 fathoms in depth; 2) shelter from rough winds and heavy waves; 3) an abundant food source; and 4) water temperatures of 21 to 25°C (Heinsohn, 1974; Heinsohn and Birch, 1972; Kingdon, 1971; Jones, 1967a; Travis, 1967; Jarman, 1966).

There is some regular daily movement between feeding grounds and deeper waters; photoperiod or tidal changes are the suspected triggers for this movement (Kingdon, 1971; Jarman, 1966; Jonklaas, 1961). Long distance migration is unknown for dugongs, but seasonal changes in their abundance in local coastal waters are apparent in east Africa, India, and the Philippines (Kingdon, 1971; Jarman, 1966; Funaioli and Simonetta, 1966; Phillips, 1927; Seale, 1915; Anderson and De Winton, 1902). This movement is associated with changing monsoons and may be in response to rough weather or variable food sources. Similar movements have not been reported from Australia.

Dugongs are mostly herbivorous and their historic distribution was broadly coincident with the tropical Indo-Pacific distribution of their food plants, the phanerogamous sea grasses of the families Posidonioaceae and Hydrocharitaceae (Kingdon, 1971). Utilized genera are Halodule, Syringodium, Zostera, Enhalus, and Cymodocea. More detailed dietary data are found in Heinsohn and Birch (1972), for Indonesia; Matlock (1960) for New South Wales; Jarman (1966) and Kingdon (1971) for Kenya; Petit (1927) for Madagascar; Prather (1929b), Jones (1960) and Jonklaas (1961) for the Indian Ocean; Gohar (1967), Anderson and De Winton (1902), and Den Hartog (1970) for the Red Sea and the Malaysian Archipelago. Although sea grasses are the primary food of dugongs, Spain and Heinsohn (1973) noted a change in diet to brown algae following a severe cyclone that caused considerable damage to local sea grass beds. Green algae were once reported from the stomach of a dugong taken in the Indian Ocean (Annadale, 1965), and Hirakasa (1952) reported a Forasian specimen containing marine algae and some crabs.

Dugongs are listed in the IUCN Red Data Book as vulnerable, except in Australia, where the species is too much reduced and continuing to decline throughout the range, apparently a result of hunting pressure (Bertram and Bertram, 1973). Legal protection is nearly complete throughout the range, but problems of law enforcement and education remains (Hoffman and Douglass, 1972). At present, no reserves, parks, or sanctuaries have resident dugongs; however, Kenya is planning a terrestrial-marine park in the Lamu region, which supports a stable population. The proposed Kasti Marine Reserve of Kenya in the Kwale area also supports dugongs (Third Internat. Cong., World Wildlife Fund, Bonn, 1973). Two sites similarly proposed for marine parks in Tanzania were withdrawn in 1968 (Ray, 1968). A site was proposed but not established (Fitter, 1968; Jonklaas, 1961; Spittle, 1960) for India and Ceylon.

Two dugongs have been held in captivity and no successful breeding in captivity has been reported (Jones, 1960, 1967a, 1967b). This species has been hunted throughout its range for its meat, likened to tender veal; its hide, used in making a good grade of leather; its oil, 3 to 8 gallons from an average adult; and its bones and tusks, used for both ivory and charcoal in sugar refining (Bertram and Bertram, 1973; Cruz, 1965; Prather, 1929b; Phillips, 1927; Annadale, 1905). Commercial dugong hunting has occurred off Ceylon (Prater, 1965) and several different cultures prized certain products of the dugongs for medicinal and aphrodisiac properties (Jones, 1967a; Allen, 1942; Hirakasa, 1954). Local small nets and stealthy harpooning are the usual techniques employed in capturing dugongs. Additional dugong mortality has been caused accidentally by shark netting and marine fishers within dugong habitat (Heinsohn, 1972; Bertram and Bertram, 1970a).

BEHAVIOR. Feeding is the predominant activity of the dugong. Interlacing bristles on the lip pads are used for grazing sea grasses (Gohar, 1957; Prather, 1929a), and the roughened mouth plate is used as a "tool" for uprooting roots and tubers (Jones, 1960). Evidence for rooting action is seen in the tusk wear, suggesting scraping or knocking against a hard substrate (Pocock, 1940). Conspicuous feeding trails through the bed of sea grass suggest that digging is the predominant activity of the dugong (Jarman, 1966). Gohar (1957), on the basis of calls, hypothesized the forerunners were used in digging; subsequent observations proved him incorrect (Jones, 1960; C. Barnett, personal communication). While grazing, dugongs drift along the substrate on their flippers (Jarman, 1966), a behavior similarly reported for the manatee (Hartman, 1971). They also drift along with the flippers dragging against the substrate, thus protruding their calcified areas (Kooyman, 1966). Capricious feeding behavior is also a feature of this species; several reports document the frequent use of the flexible flippers to stuff food masses into the mouth (Jonklaas, 1961). After grazing a mouthful of food, the head is shaken in an apparent effort to dislodge adhering refuse (Jonklaas, 1961); this action is seemingly effective, for analysis of stomach contents revealed little sand or mud (Spain and Heinsohn, 1973; Heinsohn and Birch, 1972; Prater, 1929a).

Jarman (1966) reported that dugongs feed at night, and Kingdon (1971) contends that tides are even more important than photoperiod in regulating feeding activity. He claimed that juvenile dugongs feed with the rising tide, foraging at night, while adults feed on the falling tide. Colin Barnett (personal communication) observed dugongs in Australia coming inshore most often on a rising tide, whether at dawn or dusk, although most commonly on overcast days.

Locomotion is accomplished by vertical stroking of the tail; flippers are usually tucked to the sides (C. Barnett, personal communication). Average cruising speed is about 10 km per hour (Jarman, 1966), but feeding dugongs have been estimated to swim at almost twice that speed over short distances (Jonklaas, 1961). The only grooming behavior thus far reported is that of rolling and rubbing the body in the sand (C. Barnett, personal communication).

Whistling sounds of frightened dugongs have been reported (Kingdon, 1971); calves have been bleating like eery cry (Fitter, 1968, 1947). Dugong vocalizations are believed to be used only for short-range communication (Kingdon, 1971).

Dugongs once occurred in herds up to several hundred (Crom, 1972; Bertram, 1973), although some noted large herds are now rare, although Travis (1967) reported a herd of up to 500 off the coast of Somali. These animals were not elusive; calves left the herd in the afternoon to form a nursery near the shore. When Travis washed into the water, the calves swam about his legs, rubbing against them. Groups of up to six individuals are now most common (Hughes and Oxley-Oxlund, 1971; Kingdon, 1971; Jarman, 1966). A mated pair may remain together for life; females are able to bear at any time (Macmanus, 1959); although a number of reports have not been confirmed, they may go up to 3 years between parturitions (Macmanus, 1959); in captivity, a female bred successfully for the first time at 8 years of age (Kooyman, 1966), and a male as young as 7 years (Kooyman, 1966).

Whaling and other commercial activities have caused considerable loss to the dugong (Collins, 1964). It has been quoted that the dugong is "an example of how man can effectively destroy a species" (Collins, 1964).

GENETICS. Nothing is known of the genetics of this species.

REMARKS. The dugong was named Ambyroulis by Fischer (1814:538), but because it is binomial, and no type species was designated, this name is not included in the synonymy.

LITERATURE CITED


Mammalian Species 88


Principal editor of this account was S. Anderson.

S. L. Husar, National Fish and Wildlife Laboratory, Department of Biology, University of New Mexico, Albuquerque, 87131.