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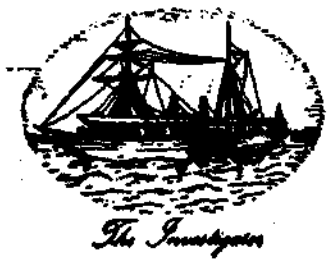

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ON THE FOOD OF STRANDED SPERM WHALE *PHYSETER MACROCEPHALUS* LINNAEUS AT TRANQUEBAR WITH A NOTE ON FOOD HABITS OF SPERM WHALES

E. G. SILAS, P. NAMMALWAR AND R. SARVESAN

Central Marine Fisheries Research Institute, Cochin-682 018, India

ABSTRACT

The present paper deals with the analysis of food contents of the stomach of the stranded sperm whale *Physeter macrocephalus* Linnaeus on 8th June, 1982 at Tranquebar on the east coast of India. Squids formed the major food item. A brief review of food of the sperm whales of the world oceans is given.

INTRODUCTION

IN RECENT years our knowledge on the feeding of the sperm whale *Physeter macrocephalus* Linnaeus has considerably grown. Most of the published information about the food of toothed and baleen whales comes mainly from the examination of the contents of the stomach of the whales either captured in the fishery or from strandings (Matthews 1932 ; Robbins *et al.* 1937 ; Mizue 1950 ; Pike 1950 ; Betesheva, 1954 ; Korabelnikov, 1959 ; Kawakami, 1959 ; 1976 ; Nemoto, 1959 ; 1962 ; 1970 ; Clarke, 1962 ; Okutani and Nemoto, 1964 ; Hisokawa and Kamiya, 1971 ; Kawamura, 1974 ; Clarke *et al.*, 1976). Eventhough, digestion appears to be very rapid in these animals (Matthews, 1978), some of the hardest parts of fishes, squids and other organisms which usually remain undigested may give a clue as to the identity of the food consumed by the whales (Fitch and Brownell, 1968). The parts of cephalopods that are not affected by digestion in whales are the horny beaks. Based on the cephalopod beaks that remain in the stomachs of the sperm whale, the feeding habits have been studied in various regions of the world oceans (Ishikawa and Wakiya, 1914 ; Clarke, 1954 ; 1955 ; Kawakami, 1959 ; 1976 ; Okutani and Nemoto, 1964 ; Clarke *et al.*, 1976 ; Okutani *et al.*, 1976). Further the, feeding habits of whales may also give an indication about their pattern of migration and movement (Buchanan, 1896 ; Pike, 1950 ; Betesheva, 1954 ; Clarke, 1957 ; Nemoto 1959 Hisokawa and Kamiya 1971 ; Mitchel, 1975 ; Sund, 1975 ; Kawamura, 1978 ; Rudge *et al.*, 1981). Such studies were also made on sperm whales which feed mainly on squids in various regions of the world oceans (Beale, 1839 ; Betesheva 1961 ; Akimushkin, 1963 ; Caldwell *et al.*, 1966 ; Berzine, 1972 ; Best, 1974 ; Clarke *et al.*, 1976 ; Slijper, 1979 ; Allen, 1980).

Though strandings of sperm whales along the Indian coasts have been reported by earlier workers (Blanford, 1891 ; Antony Raja and Pai, 1973 ; Bande *et al.*, 1980 ; James and Manivasagam, 1980 ; James and Soundararajan, 1980; Nammalwar and Thanapathi, 1982), only very few workers have reported on the stomach contents (Moses, 1940 ; Jacob and Menon, 1947 ; Daniel, 1963). Some of the remains of food in the stomach of the sperm whale can be ascertained even in the decomposed condition as it is possible to retrieve the beaks

of cephalopods and skeletal parts of fishes. In this context, the food of sperm whales in Indian seas and other regions of the world oceans should be of interest. The present paper deals with the food items of a 9.06 m male sperm whale stranded at Tranquebar (11°0'N and 79°8'E) on the East coast of India on 8 June 1982. The carcass was cut open on the 8th day of stranding. The beaks of squids, squid remains and semi-digested sea grass were found in the stomach.

Among 158 beaks collected, 8 beaks (6 upper and 2 lower beaks) were removed and examined. The study revealed that they belong to the genus *Chiroteuthis*. It may be pointed out that *Chiroteuthis imperator* Chun, has been recorded from the Indian ocean (Chun, 1910 ; Massy, 1916) as referred by Clarke (1966) and Silas (1968). The soft part of the squid remains could not be assigned to any species as they were beyond identification.

Review of the food of sperm whales

Pacific Ocean

According to available data, 25 species of cephalopoda and 38 species of fishes have been identified from the stomachs of sperm whales around Japan and Kuriles waters (Mizue, 1950 ; Betesheva and Akimushkin, 1955 ; Betesheva, 1960). The main food items in this region are squid of the family Gonatidae. They were encountered in the stomachs of practically all sperm whales and constituted on an average 50-80% of all cephalopoda (Tarasevich, 1963). Betesheva (1961) reported that more than 24 species of fish, among them the macrurids taking first place were found in 33-60% of stomachs, while second and third in importance are sharks and Alepisaurus. The following demersal fish are of considerable significance for a sperm whale in this region, according to Betesheva (1961) ; Rays (*Raja spp.*) gobies (*Myoxocephalus* sp.,) anglerfish (*Onelrodes* sp.) cottidae and Walleye pollock. According to the data of Mizue (1950), based on the analysis of feeding data from the southern waters of Japan, the incidence of redfish (*Sebastodes* sp.) clupeids (*Sardina* sp.), mackerel (*Scomber* sp.) and krill can be added to the list of food items. Zenkovich (1934, 1937) and Tomilin (1936) reported that the stomachs of sperm whales taken in the northernmost komandorski-kamchatka region contained squids (*Gonatus* sp.), Octopods (*Octopus* sp.), and crabs. Rays (*Raja* sp.) and fishes (*Scorpaenidae*) were also found in sperm whale stomachs. Sleptsov (1952) reported that the sperm whales from Bering sea and of the kuriles feed on Pacific lamprey (*Entosphenus* sp.), Pacific cod (*Gadus* sp.) greenling (*Pleurogrammus* sp.) and on *Macrurus* sp.

Berzin (1959) reported that sperm whales from Komandorski area and western part of the Aleutian Islands feed on squid of the (family *Gonatidae*) species *Gonatopsis borealis, Meleagroteuthis separata, Galiteuthis armata, Onychoteuthis banksii* and *Chiroteuthis veranyi*.

The fishes found in sperm whale stomachs in the Bering sea and in the adjacent regions of the Pacific contained representatives of 8 families : Agonidae, Scorpaenidae, Plagyodontidae, Rajidae, Petromyzonidae, Cottidae, Cyclopteridae, and Macruridae. Okutani and Nemoto (1964) reported that the sperm whales near the Aleutian Islands, in the Gulf of Alaska and in the Bering sea feed on the squids *Mastigoteuthis* sp. and *Stigmatoteuthis* sp. Robbins, *et al.* (1937), reported the presence of *M. robusta* and *M. octopi* as well as of small cod and lamprey in the stomachs of sperm whales. Pike (1950) points out that the diet of sperm whale in the waters of British columbia includes large amounts of the squid *Gonatus* sp. and *M. robusta*. Rays (*Raja* sp.) and lampreys and salmons and eggs of squid were also observed.

Recently, Tarasevich (1968) reported that the food item of sperm whales from the north eastern Pacific showed the squid species *Taonius*

Plate 1. Beaks of squids belonging to the genus *Chiroteuthis*; A. Upper beak and B. Lower beak.

pavo, Chiroteuthis veranyi, Meleogroteuthis separata, Galiteuthis armata, Architeuthis japonica, Octopodoteuthis longiptera, Gonatopsis borealis, Stigmatoteuthis dolfeini, Onychoteuthis banksii, Alloposus mollis and *Octopus gilbertianus*.

In the stomachs of sperm whales taken in the southwestern Pacific (regions of New Zealand, Chatham Island and Tasmania), the cephalopods *Stenoteuthis, Histioteuthis, Onychoteuthis* and *Architeuthis* and Octopoda were found. Among the fishes, representatives of the family *Scorpaenidae, Chimaeridae* and rays (*Raja* sp.) and their eggs and sharks were also noted. In addition, colonial tunicates (*Pyrosoma*) and shrimp were also noted as food items. Okutani and Satake (1978) reported the diet of sperm whales caught in the Pacific waters off Northeastern Honshu, Japan. They found that among the squids, *Histioteuthis doflenini* was the dominant species (52%) followed by *Octopoteuthis* (26%).

Atlantic Ocean

Clarke (1955, 1962), reported 8 species of squid form sperm whales in the northern part of the Atlantic ocean, particularly the area of the Azores and Madeira. *Histioteuthis bonelliana* and *Cucioteuthis unguiculatus* occur most frequently. Among the squids, *Architeuthis, Lepidoteuthis* and *Cucioteuthis* constitute about 7% of the total weight of molluscs. Octopoda and Cranchiidae constitute in mass about 3% of the total weight of molluscs. Clarke (1956) further reported the occurrence of four species of fishes, namely barracuda yellowfin tuna, and two species of anglerfish (*Ceratias holboeli* and *Himantolophus*). Tomilin (1957) mentions the discovery of a large eel (*Anguilla* sp.) in the stomach of a sperm whale. Backus (1966) reports, *Alepisaurus* and sharks (Cetorhinus) in the stomach of sperm whales. Matthews (1938) found that the stomach contents of sperm whales taken off the southwest shores of Africa (Southern regions of Atlantic ocean) constitute cephalopoda and teleosts. Akimushkin (1963) determined squid, *Octopodeuthis longiptera* from the stomach of the sperm whale taken in the south Atlantic.

Indian Ocean

There is hardly any data on the feeding of sperm whales in the Indian ocean. Matthews (1938) gave information on the quantitative stomach fullness of sperm whales from southeastern Africa and a general indication as to the part played in the diet by cephalopoda and teleosts in this region. Tomilin (1957) reported that an unidentified species of shark was extracted from the stomach of a sperm whale in the same region. Hollis (1939) reported that sperm whales from the Australian coasts of the Indian ocean feed on Octopoda. In the stomachs of sperm whales taken from the Indian ocean in the region northwest and west of Australia as far as the islands of New Amsterdam and Heard and their vicinity the following species of squids were found : *Moroteuthis robusta, Histioteuthis bonelliana, Stenoteuthis bartrami* and *Architeuthis* sp. Among fishes, quite frequent occurrence of barracuda, *sphyraena* sp., Porcupine fish, *Diodon* sp. and representatives of the family Ceratiidae in the stomachs of Indian ocean sperm whales were observed.

Antarctic Ocean

Matthews (1938) carried out investigations on the quantitative stomach fullness of the sperm whales in the waters of South Georgia Island but did not specifically determine the food remains from the stomachs which were indicated only as presence of cephalopoda and teleosts in various stages of digestion. Korabel'nikov (1959) reported three species of squids in the stomachs of sperm whales captured in the southern Orkney Islands.

Evidently, *Onychoteuthis banksii* is of prime importance in the diet and predominates in the stomachs of sperm whales taken in all the whaling areas of the Antarctic. Remains of *Architeuthis* were found in the stomach of sperm whales captured from farther west in the region east of the South Shetland Islands. *Moroteuthis robusta* from the northeast of the Balleny Islands should be considered part of the food of sperm whales in the Antarctic. Korabel'nikov (1959) reported that fishes (*Micromesistius australis*) and rays (*Raja griscocaudata*) were found in the stomach of sperm whale caught south of the Falkland Islands. Clarke (1954) and Solyanik (1963) have indicated that sperm whales feed on the anglerfish *Ceratias holboeli*. This review of available data shows that in the Antarctic, fish is of lesser significance for the sperm whale than in other regions of the world oceans. Korabel'nikov (1959) also mentions finding large crustacea in the stomach of some sperm whales.

Discussion

The basic diet of sperm whales in all regions of the world ocean is made up of approximately 40 species of cephalopoda, including 9 species of octopoda. Squid is of far greater importance than octopus everywhere, amounting to 80% of the entire food bolus (Akimushkin, 1955). Because of our knowledge of the feeding of sperm whales in the different oceans is uneven, it is difficult to make a complete analysis from the comparative geographical aspect. *Moroteuthis*, *Architeuthis* and *Onychoteuthis* are food items in all oceans.

More than 50 species of fish have been found in the stomachs of sperm whales inhabiting various regions of the world oceans, the large majority of these in sperm whales that were captured in the North Pacific. The poor species composition of cephalopoda and fish eaten by sperm whales in the Atlantic and Indian Oceans and in Antarctic waters is apparently explained by the scarcity of knowledge on feeding in these areas. Five species of deep-sea Gadidae are food for the sperm whale in all regions of the world ocean. The family scorpaenidae is represented by 6 species which are noted only in the stomachs of sperm whales from the North Pacific. Two families of sharks, squalidae and squatinidae are found in the diet of sperm whales in the Pacific ocean. Even a cursory analysis of the contents of sperm whale stomachs shows that their food spectrum is strictly limited to deep-sea organisms. The proportion of various food items can vary greatly in different regions and in the same region according to months, seasons and years and also depending on the sex and age of the whales ; nevertheless, various species of cephalopoda predominate almost always and everywhere. At least 95% of the entire mass of food consumed consists of cephalopoda and about 5% of fish. Betesheva (1960) reported that a change of the species composition of the food depended on the distance of the feeding areas from the shore (*i.e.*,depending on depths). Whereas, the stomachs of sperm whales caught in the littoral waters of Japan, in the shallow waters of the Sarycheve, Onekotan, Paramushir and Shumshu islands (Kuriles) in the region of Cape Olyutorskii and in the shallow waters of the Komandorski islands, contained in addition to squid, small Octopoda, Scorpaenidae, and Gadidae, rays and gobies. The stomachs of sperm whales captured in the kuriles area at great depth disclosed mainly pelagic species : squid, sharks, and deep-sea fishes (Macrurus, Alepisaurus and anglerfish).

Hollis (1939) reported that crustacea may be present in the stomachs of sperm whales if they feed in the near-bottom layers, for instance remains were found of five species of crab namely, as *Paralithodes camtshatica*, *P. brevipes*, *Pagurus* sp. and two species of bivalve molluscs. Many researchers point out that demersal organisms-sponges, starfish, sea-cucumbers and ascidians find their way into the stomach of sperm whales

(Akimushkin, 1954 ; Clarke, 1956 ; Berzin, 1959 ; Nemoto, 1963 and Nazu, 1963). Mizue (1950) has noted krill in the food of sperm whales. Ash (1962) discovered shrimp and Andrews (1916) mentioned lobster to be part of the diet. The diet of sperm whales depends entirely on the composition of food items inhabiting the same horizons where sperm whales feed in a particular region. Thus according to Okutani and Nemoto (1964) the farther away from the Allutian Islands in the Bering sea, the more fish begin to prevail in the diet and on the other hand, in the littoral zone of the Gulf of Alaska, fish are predominant, while squid prevail in the middle of the gulf.

The stomach of the sperm whale is usually filled with remains of bodies of cephalopoda—heads with crowns of tentacles separated from the trunk (mantle), numerous chitinous jaws (rostra), belonging to cephalopods (Tomilion, 1957). Many published confirmation exist on the extreme abundance of shoals of cephalopoda (Akimushkin, 1955). Together with the shoals of squid that are relatively monotonous in regard to species, the stomachs of sperm whales may contain upto 22 species of cephalopoda simultaneously (Betesheva and Akimushkin, 1955). These data imply the presence of multi-species shoals (or concentrations) of cephalopoda in the deep waters.

Because of the fact that sperm whales are found to feed more frequently on cephalopoda and fishes than other organisms, Berzin (1972) suggested that sperm whales could be more appropriately called 'teuthoichthyophages'.

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