Stomach Content Analysis of a Dugong (*Dugong dugon*) from South Sulawesi, Indonesia

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Abstract

A quantitative analysis of the stomach contents of an individual female dugong (*Dugong dugon*) caught by fishermen in February 1991 in the coastal waters of South Sulawesi, Indonesia, is presented. Of the total dry weight of digesta (about 3.4 kg), 98.9% consisted of seagrass material. Rhizome and root material of smaller pioneering genera (i.e. *Halophila*, *Halodule*, *Cymodocea*) accounted for 71.5% of the total dry weight. *Enhalus acoroides* dominated among leaf material (about 50%), but its contribution to the total biomass of the stomach contents was only 13.5%. Rhizome material of *Enhalus* and *Thalassia* was absent. The amount of sediment in the stomach was negligible. The results are compared with those from similar studies, and the implications for possible feeding selectivity are discussed.

Introduction

The dugong, *Dugong dugon* (Müller), is a truly marine, herbivorous mammal, known to feed predominantly on seagrasses. Although observations derived from the stomach contents of a single dugong might not be sufficient to draw conclusions about the feeding ecology of the species, the increasing amount of recent literature on the stomach contents of dugongs from other areas enables a comparison to be made. The IUCN Mammal Red Data Book (Heinsohn 1982) gives the status of the dugong as 'vulnerable', which justifies the publication of any available information on the species. It is unlikely that large numbers of dugongs will become available for analysis in Indonesia, where dugong populations are considered to be under pressure and the species has been given a protected status. The present paper reports the analysis of the stomach contents of a dugong from South Sulawesi, Indonesia.

Materials and Methods

An adult female dugong was accidentally caught in the nets of a local fisherman on 22 February 1991 at Bone Lola, a shallow submerged reef north of Barang Lompo island in the Spermonde Archipelago, South Sulawesi (Fig. 1). The animal was sold to a fishing family at the island and slaughtered for its meat (reportedly about 70 kg). The authors were able to purchase the stomach for analysis of its contents. The full stomach measured roughly 30×50 cm and had a total weight of about 23 kg. Approximately 20 kg (wet weight) of macerated plant material was present in the stomach. A sample of the stomach contents was dried at 80°C to constant dry weight; this sample contained 83% water, indicating a total dry weight of 3.4 kg of plant material in the stomach. Three samples of digesta (about 5 g wet weight each) were randomly taken from the cardiac region of the main sac of the stomach and preserved in 4% formaldehyde in sea water.

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Fig. 1. Study area, showing the localities mentioned in the text.

Fragments of plant tissue from the three preserved samples were analysed microscopically and compared with a reference collection of seagrass leaf tissues. In all, 11 seagrass species of seven genera occur in the Spermonde Archipelago and adjacent coastal areas of South Sulawesi (Erftemeijer, unpublished data). The reference collection covered representative species of all seven genera that were collected in the study area. Epidermal-cell morphology, which shows characteristic differences in size and shape for all of the seagrass genera present in the study area, was used for reliable identifications according to the methods of Channells and Morrissey (1981).

In all, 2933 fragments of plant tissue (divided over the three samples) were identified and categorized according to genus for the leaf material; rhizome + root material and algal tissue (both of which were not identified to genus) were recorded as separate categories. After the total numbers of fragments in each category were counted, the sorted tissues from each sample were dried separately for 48 h at 80°C to determine the dry weights.

Results

The stomach contents of the female dugong in this study consisted almost entirely of seagrass tissue, which accounted for about 99% of the total dry weight (Table 1). Algae represented only 0.5% (dry weight) of the stomach contents, although epiphytic microalgae may have been overlooked. Indeed, the dugong is reported to feed almost exclusively on seagrasses throughout its range (Lanyon *et al.* 1989), eating significant amounts of algae only when seagrasses are scarce (Spain and Heinsohn 1973; Heinsohn and Spain 1974). The genus *Enhalus* (represented only by a single species, *Enhalus acoroides*) occurred most frequently

and accounted for more than 50% of all leaf fragments in the samples and for 13.5% of the total dry weight. Leaf material of the genus *Halophila* (of which three species occur in the area) was also remarkably frequent in the samples but accounted for only 6.7% of the total dry weight. Other genera encountered included *Thalassia*, *Halodule*, *Cymodocea* and *Syringodium*, but none of these occurred in considerable proportions. Of the total number of tissue fragments investigated, 31% was rhizome and root material, which accounted for 71.5% of the total dry weight. Although rhizome material was not identified to genus, it was noticed that rhizomes from *Enhalus acoroides* and *Thalassia hemprichii* were absent. These two species have rhizomes and roots that penetrate deeply into sediments and so are not easily removed and eaten. In addition, the rhizomes of these two species have distinct cuticles and thickened and lignified cell walls. The absence of rhizomes of *Enhalus* and *Thalassia* from the stomachs of dugongs has been reported earlier (Anderson 1981; Marsh *et al.* 1982; Lanyon *et al.* 1989). No parasitic nematodes or other parasites were found in the cardiac sac of the stomach. The amount of sediment in the stomach was negligible. Heinsohn and Birch (1972) also reported very little sand in dugong digesta.

Table 1. Composition of the stomach contents of a female dugong from South Sulawesi, Indonesia, showing relative frequencies and dry-weight compositions of leaf tissues of seagrass genera, macroalgae, unidentified remains and seagrass rhizome and root material ($n=3$ samples; total number of plant fragments = 2933)

	Relative frequency (%) $\bar{X} \pm \text{s.d.}$	Dry-weight composition (%) $\bar{X} \pm \text{s.d.}$
<i>Enhalus</i>	35.7 ± 6.3	13.5 ± 1.1
<i>Halophila</i>	15.2 ± 5.4	6.7 ± 1.4
<i>Halodule</i>	6.0 ± 1.6	1.0 ± 0.4
<i>Thalassia</i>	5.4 ± 1.4	2.1 ± 0.4
<i>Cymodocea</i>	4.7 ± 1.4	2.6 ± 0.4
<i>Syringodium</i>	0.3 ± 0.2	1.5 ± 0.9
Macroalgae	0.7 ± 0.5	0.5 ± 0.4
Unidentified	0.9 ± 1.1	0.5 ± 0.4
Rhizome and root material	31.1 ± 8.0	71.5 ± 1.0

Discussion

The dominance of *Enhalus acoroides* among the leaf fragments in the stomach contents of the female dugong in this study contrasts with several reports for other areas (Gohar 1957; Lipkin 1975; Wake 1975; Anderson and Birtles 1978) where smaller, pioneering species, notably *Halodule uninervis*, dominated in dugong stomachs. Recent studies in Ambon (Indonesia) also indicate a strong preference by the dugong population in that area for sparse stands of *Halodule uninervis* (de Jongh 1990; Brasseur and de Jong 1991). Dugong feeding tracks were found almost exclusively in intertidal *Halodule* stands, although five other species, including *Enhalus acoroides*, occurred in dense beds nearby. *Halodule* occurred in 95% of 96 stomachs from Queensland dugongs, accounting for 44% of the non-rhizomatous portion in the stomachs (Marsh *et al.* 1982). The study by Marsh *et al.* (1982) showed variability among individual dugongs in the dominant species of seagrass eaten, which might put in doubt conclusions drawn from a single animal. Several authors have supported the view that dugongs feed according to food availability within selected feeding areas (Wake 1975; Heinsohn 1981; Marsh *et al.* 1982). During aerial surveys in

Australia, the highest densities of dugongs were seen in coastal seagrass beds (Lanyon *et al.* 1989). Heinsohn *et al.* (1977) also reported a preference by dugongs for foraging in shallow coastal waters. Several shallow areas along the western coast of the southern part of South Sulawesi are characterized by monospecific seagrass beds of *Enhalus acoroides* bordered by mangroves (which have largely been converted into fish ponds). Conversely, mixed seagrass beds with up to four or five species occur on the shallow reef flats of the coral islands off the coast. Judging from the relative frequencies of leaf material from the different seagrass species in the stomach of the dugong in the present study, one might conclude that this dugong had been foraging primarily in coastal (*Enhalus*) seagrass beds.

However, when the total stomach contents are taken into consideration (i.e. including the rhizomatous portion), smaller pioneering genera clearly dominate. Rhizome and root material of smaller species accounted for over 70% of the total dry weight. This indicates that the dugong had been foraging primarily on smaller pioneering seagrass species rather than on *Enhalus*.

No feeding tracks of dugongs were observed in the study area, although some reports (Allen *et al.* 1976) and interviews with local fishermen suggest that dugongs are still frequenting the area, albeit in low numbers. However, if grazing pressure is low (as is implied by the low numbers of animals reported from this area), feeding trails may not be abundant, even when the seagrass beds consist of mixed species. Besides, as suggested by Brasseur and de Jong (1991), feeding tracks are probably absent in localities where tall-growing seagrass species predominate (i.e. *Amphibolis antarctica*, *Enhalus acoroides*, *Thalassia hemprichii*) since the grazing of dugongs on these species is limited to the leaves. Feeding tracks are formed only when the dugongs dig up the whole plant, including the rhizomes. In this respect, Anderson (1991) recently suggested that the common name of the dugong should be changed to 'sea pig', with 'river cow' being a more appropriate name for the closely related manatee, which does not show such digging behaviour.

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