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# Some Biological Aspects of Penaeid Shrimps Inhabiting Yumurtalık Bight in İskenderun Bay (North-Eastern Mediterranean)

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**Abstract:** The species composition, size frequency distribution and length/weight relationships for each sex, size at first sexual maturity, and spawning seasons of the commercially important shrimp species inhabiting Yumurtalık Bight of the Nort-eastern Mediterranean were studied.

Two penaeid shrimp species, *Penaeus semisulcatus* and *Metapenaeus stebbingi*, dominated the catches. Only a few individuals of *Metapenaeus monoceros* were captured during the study. The minimum size at first maturity was estimated to be 130 mm total length (TL) for *P. semisulcatus* and 55-60 mm TL for *M. stebbingi*. The size at which 50% of the population is mature is 36 mm carapace length (CL) for *P. semisulcatus* and 15.4 mm CL for *M. stebbingi.* The highest proportion of mature females was encountered between the early spring and summer months when mater temperatures were relatively high. Most mature spawners were captured at a water depth of 5-10 m for *M. stebbingi* and 20-30 m for *P. semisulcatus.* The results showed that while *P. semisulcatus* does not spawn in the bight in winter months, *M. stebbingi* was not present in the bight from September through the winter months.

**Key Words:** Shrimp, *Penaeus semisulcatus, Metapenaeus stebbingi,* sexual maturity, length/weight relationship.

## İskenderun Körfezi'nin Yumurtalık Koyu'nda Bulunan Penaeid Karideslerin Bazı Biyolojik Özellikleri

**Özet:** Bu çalışmada, Kuzey-doğu Akdeniz'deki, Yumurtalık Koyu'nda yaşayan ticari karideslerin, tür kompozisyonu, boy frekans dağılımı, her eşey için boy/ağırlık ilişkisi, ilk eşeysel olgunluk boyu ve yıl boyu üreme dönemleri araştırılmıştır.

Yakalanan karideslerin büyük bir kısmını iki karides türü, *Penaeus semisulcatus* ve *Metapenaeus stebbingi* oluşturmuştur. Çalışma esnasında, *Metapenaeus monoceros'a* ait olan sadece birkaç bireye rastlanmıştır. Minimum eşeysel olgunluk total boyu (TB) *P. semisulcatus* için 130 mm, *M. stebbingi* için ise 55-60 mm (TB) olarak hesaplanmıştır. Populasyonun %50'sinin eşeysel olgunluğa ulaştığı karapas boyu *P. semisulcatus* için 36 mm ve *M. stebbingi* için ise 15.4 mm olarak belirlenmiştir. Yumurtlama aşamasında olan dişilerin oranının en fazla olduğu dönem, su sıcaklığının yüksek olduğu erken ilkbahar ve yaz ayları olarak belirlenmiştir. *P. semisulcatus* olgun anaçlarının çoğu 20-30 m derinliklerde, *M. stebbingi* anaçları ise 5-10 m derinliklerde yakalanmıştır. Araştırma sonuçları, *P. semisulcatus*'un kış aylarında, bu koyda yumurtlamadığını, *M. stebbingi*'nin ise Eylül'den itibaren kış ayları boyunca koyda bulunmadığını göstermiştir.

**Anahtar Sözcükler:** Karides, *Penaeus semisulcatus, Metapenaeus stebbingi,* eşeysel olgunluk, boy/ağırlık ilişkisi.

## Introduction

Out of 61 species identified up to date, only seven shrimp species have been reported to be commercially important for Turkish fisheries (1). All of these commercial species (*Penaeus semisulcatus, P. japonicus, P. kerathurus, Metapenaeus monoceros, M. stebbingi, Parapenaeus longirostris* and *Trachypenaeus curvirostris*) are commonly caught by trawlers in the neritic waters of North-eastern Mediterranean. Although the biology and fisheries of these penaeid shrimps have been studied in other Mediterranean countries (2, 3, 4) and the Arabian Gulf (5, 6), there is only one investigation dealing with the distribution, species abundance and length/weight relationship of shrimp species in Mersin Bay of Turkey (7).

Shrimp culture is already practised by a few private companies in Turkey and is expected to gain popularity in the near future. Data on seasonal availability of mature

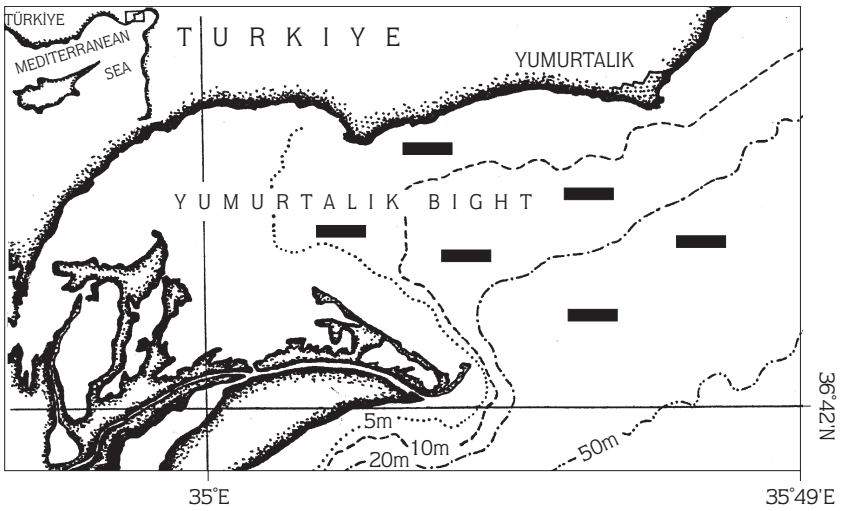


Figure 1. Map of Yumurtalık Bight of North-eastern Mediterranean. (▬ =sampling stations).

broodstock are of importance for the developing shrimp industry.

Hence, the present investigation was carried out to study some biological aspects, e.g., species composition, size frequency, lengt/weight relationship, size at first maturity and sexual maturity stage of penaeid shrimps inhabiting the Yumurtalık Bight of the North-eastern Mediterranean during a one-year period.

## Materials and Methods

The data were obtained from monthly catches in Yumurtalık Bight between May 1996 and January 1997. Regular samplings of shrimps were made by means of a bottom trawl net (14 mm mesh cod ends) every month during a period of 9 months. Trawl shots of about 30 minutes were undertaken at each sampling station at depths of between 5 and 30 m (see Fig. 1). The samples were used to determine species composition, size frequency, length/weight relationship, size at first sexual maturity and sexual stage of the shrimps.

For this reason, the species in each sample were identified, and females and males were sorted by visible thelycum or petesma. All individuals were weighed to the nearest 0.01 g and measured with vernier callipers for their total length (TL) from tip of the rostrum to end of the telson and also carapace length (CL) from post orbital margin to the posterior end of the mid-dosal line of the carapace using vernier callipers. The degree of sexual maturity of females was done by inspection of the ovarium in the fresh animals. The following distinctions were made to assess the maturation stage of the ovarium:

a. Stage 1 (immature): ovaries are thin, transparent and difficult to see.

b. Stage 2 (early maturing): ovaries are visible and wider.

c. Stage 3 (nearly ripe): ovaries are clearly visible and wider in the 1st abdominal segment and their colour is whitish to pale yellow.

d. Stage 4 (ripe): Ovaries occupy all available spaces in the abdomen and cephalothorax and laterally swell in the 1st and 2nd abdominal segments. The color is light green (4, 6).

The smallest size of males having just completed formation of the petesma was also recorded. During each cruise, surface water temperature and salinity were also measured.

## Results

### Salinity/temperature

The salinity of the bight did not change much throughout the course of this study. Salinity was slightly higher in the summer months (38.8-39.6 ppt) than in the winter months (36.5-38.2 ppt). Temperatures ranged from 25.3 to 28.2°C in summer months, 24 to 27°C in autumn, and 15.2°C to 17.5°C in winter months.

### Species composition

Throughout the entire study period, only two penaeid shrimp species, *P. semisulcatus* and *M. stebbingi* dominated the catch. In May 1995, *P. semisulcatus* constituted more than 85% of the total shrimp catch while the reverse was true for *M. stebbingi* from june to

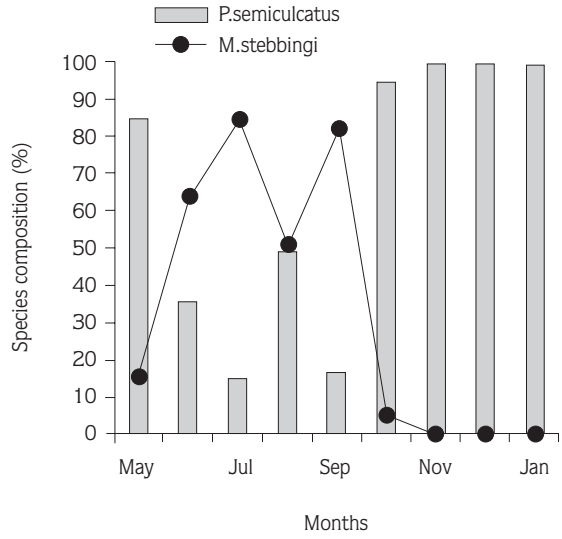


Figure 2. Species composition of shrimps (%) caught in yumurtalik Bight during a period of 9 months.

September (Fig. 2). No any *M. stebbingi* individuals were caught during the winter months at all. Only a few individuals of *M. monoceros* were caught during the study.

### Length frequency distribution

The size of male *P. semisulcatus* (as total length) caught during the present study ranged from 70 mm to 170 mm, while the size range of the females was between 70 mm and 220 mm (Fig. 3). The largest female and male were 220 mm and 170 mm, respectively. Total length of male *M. stebbingi* ranged from 30 mm to 65 mm, while females had a wider range of size distribution, between 35 mm and 105 mm. The length frequency distribution of the males of the two shrimp species was characterised by sharp peaks owing to the narrower size range of the males. The size distributions of the females were more level.

### Length at first maturity

When total length and percentage of mature females (at ovarian stages 3 and 4) were plotted, the smallest size at first maturity was found for each shrimp species. Fig. 4 shows that *P. semisulcatus* females reach minimum sexual maturity size at about 130 mm TL. Observation of males of *P. semisulcatus* showed that they completely form the petesma (the external copulation organ) when they are about 110 mm in total length (11 g). The smallest *M. stebbingi* females reach sexual maturity at a much smaller size, about 55-60 mm TL and 0.7-1 g (Fig. 4).

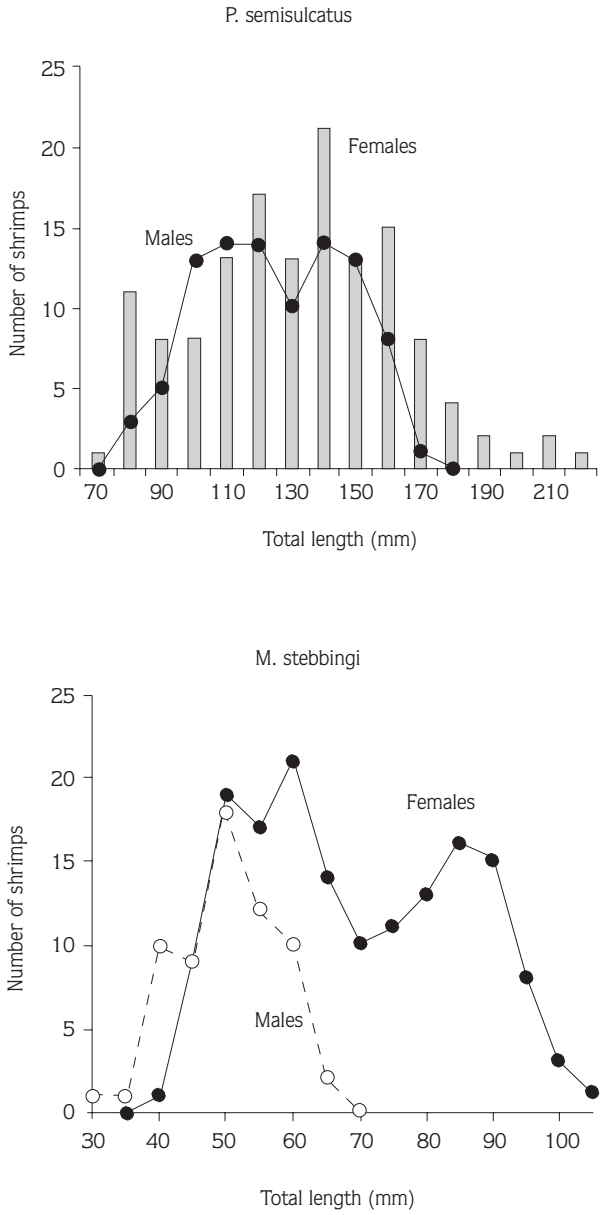


Figure 3. Size frequency distribution of males and females of *P. semisulcatus* and *M. stebbingi* caught in Yumurtalik Bight.

When the percentage of mature females was plotted against CL, it was foud that *P. semisulcatus* females reach minimum maturity at a CL of 30 mm, whereas *M. stebbingi* females reach this stage at the carapace length of 11 mm (Fig. 5 and 6). Only 12.5% of *P. semisulcatus* females were mature at 30 mm CL, but the proportion rose rapidly above this size. While only 11% of *M. stebbingi* females were mature, again the percentage rose to 70-100% at larger CL. The highest percentages of

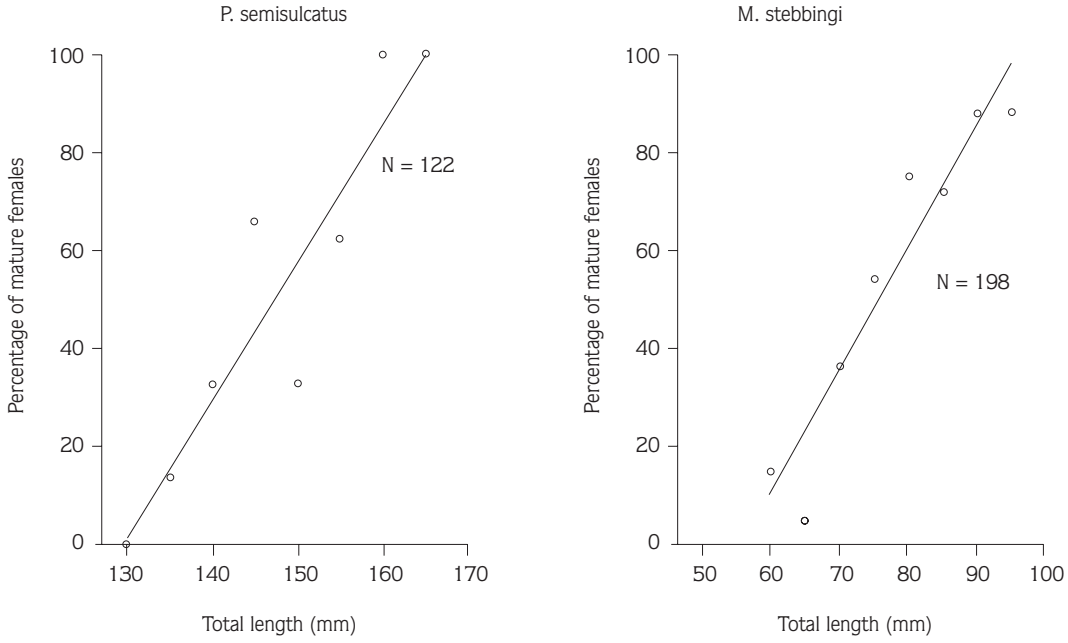


Figure 4. Length at minimum first maturity of *P. semisulcatus* and *M. stebbingi*.

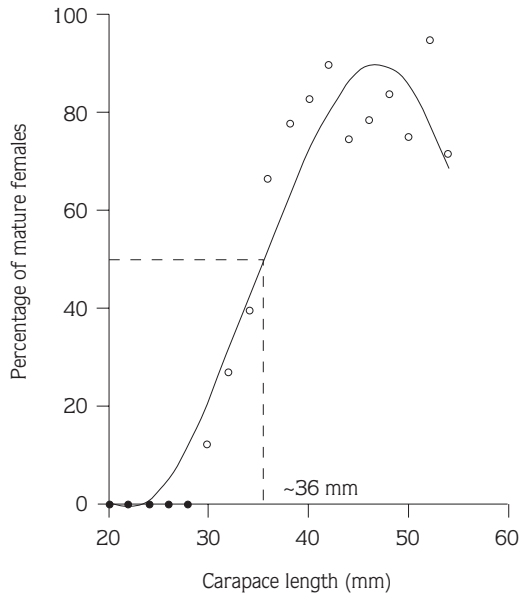


Figure 5. Relationship between percentage of mature female *P. semisulcatus* and size (CL).

mature females in *P. semisulcatus* and *M. stebbingi* were found to be between 38-54 mm and 16-23 mm CL, respectively. Using the curves in Figs 5 and 6, it can be reasonably stated that the size at which 50% of the population is mature is 36 mm CL for *P. semisulcatus* and 15.4 mm CL for *M. stebbingi.* The curve goes downward after the CL of 46 mm (see Fig. 5), indicating a high proportion of post spawning activity in *P. semisulcatus* at large sizes.

### Seasonal maturity

The percentage of mature females of *P. semisulcatus* was highest between May and July . 88% of the females were about to spawn in July (Fig. 7). There was a small percentage of mature females between August and November. None of the females captured in December and January were mature. Similarly, the highest percentage of mature *M. stebbingi* females (55-75%) was found between May and June. The percentage of mature females between July and September ranged from 12 to 32%. No individuals belonging to this species were caught between September and January in the Yumurtalık Bight. It appears that the spawning period of *P. semisulcatus* is longer than that of *M. stebbingi* in Yumurtalık Bight (Fig. 7).

### Length/weight relationship

The regression of log weight on log length gave a linear relationship expressed by log W = log a + b Log L. The lengt/weight relationships were determined separately for the males and females of *P. semisulcatus*

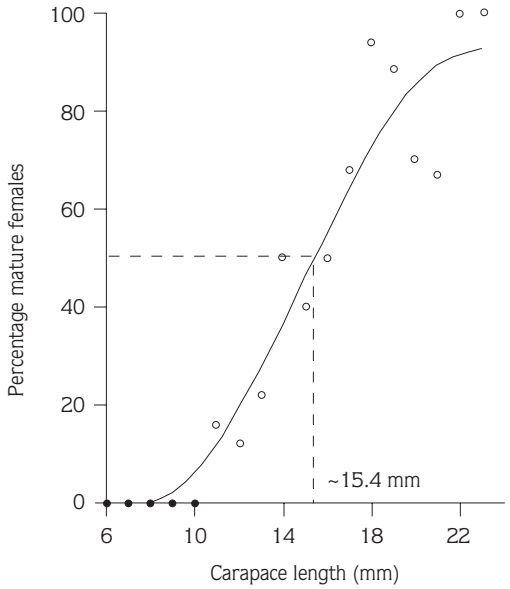


Figure 6. Relationship between percentage of mature female of *M. stebbingi* and size (CL).

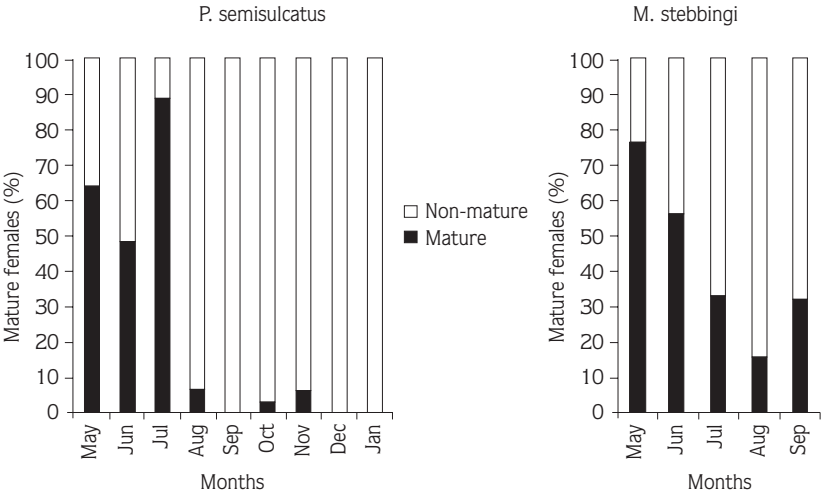


Figure 7. Percentage of mature females (ovarium stage 3/4) of *P. semisulcatus* and *M. stebbingi* caught in Yumurtalik Bight.

and *M. stebbingi* by the general formula $W = aL^b$, where W is the weight in grams, L the length in cm, and a and b are the constants to be calculated. The length/weight relationships for each species and sex were calculated and are shown in Table 1. This table shows that males of *P. semisulcatus* and females of *M. stebbingi* have fusiform body shape. Condition factors of the males, however, were higher in males than in the females of both species.

Table 1. Length/weight relationship equations of the two shrimp species inhabiting Yumurtalık Bight.

| | P. semisulcatus | M. stebbingi |
|---|---|---|
| Female | $W=0.0045\ L^{3.25}$ | $W=0.0081\ L^{2.96}$ |
| Male | $W=0.0072\ L^{3.04}$ | $W=0.0129\ L^{2.67}$ |

## Discussion

The present results demonstrate that only two commercially important penaeid shrimp species, *P. semisulcatus* and *M. stebbingi,* inhabit Yumurtalık Bight at depths of between 5-30 m. Only a few specimens of *M. monoceros* were captured during the study. Both species were abundant during the warmer months (May to September) while *M. stebbingi* disappeared in the cooler

months (October to January) in the bight. It apears that this species moves out of the bight to probably deeper warmer waters when the temperature is low.

In both species, females grow to a larger size than males. The length/weight relationships summarised in Table 1 also support this suggestion. The largest female and male of *P. semisulcatus* encountered during the current study were recorded as 220 mm TL (104 g) and 170 mm TL (32.4 g), respectively. The largest female and male of *M. stebbingi* measured 104 mm TL (7.66 g) and 66.8 mm TL (2.11 g), respectively. The presence of *P. semisulcatus* in catches throughout the study period shows that this species inhabits the bight throughout the year. Notably, it is the only shrimp species that can be fished in the bight in winter months.

*P. semisulcatus* and *M. stebbingi* females reach their minimum first sexual maturity size at about 130 mm and 55-60 mm TL. The result for *P. semisulcatus* agrees with the finding of Abdel Razek (4), who studied *P. semisulcatus* on the Egyptian Mediterranean coast. The minimum first sexual maturity size of *M. stebbingi* reported in the present study (55-60 mm TL) is smaller than the sizes (88 and 93.0 mm TL) reported by Badawi (5) and Abdel Razek (4). In the current study, there were some females with ovarium stage 4 at only 50 mm total length. Hence, it appears that this species reaches sexual maturity earlier than other *M. stebbingi* populations elsewhere. Females of the two shrimp species attained first sexual maturity at a relatively small size in comparison with their maximum size, indicating that these species should spawn many times during their life span. Badawi (5) reports that *P. semisulcatus* spawn five times in their lives.

The size at which 50% of the population is mature may be a good indicator of size at large-scale spawning in the population. Hence, the size at which 50% of the population is mature ise 36 mm CL for *P. semisulcatus* and 15.4 mm CL for *M. stebbingi.* The size was 39 mm CL for *P. semisulcatus* from the North-western Gulf of Carpentaria, Australia (8).

Concomitant with rising water temperature in summer months (May to August), the proportion of active spawners in the population increased. The finding of females with ovarium stages of 3-4 indicates that both *P. semisulcatus* and *M. stebbingi* females spawn in Yumurtalık Bight. While spawners of *M. stebbingi* were caught particularly at water depths of 5-10 m, most mature *P. semisulcatus* females were abundant at depths of 20-30 m. It is known that the spawning season of shrimps may change from one geographic area to another. For example, Mohammed et al. (9) report two spawning peaks for *P. semisulcatus* around March-April and October-Nowember in Qatar waters, while Badawi (5) found the greatest breeding activity of this species between October and April in the Arabian Gulf. Abdel Razek (4), however, reports that the spawning season of *P. semisulcatus* lasts from January to September. In Yumurtalık Bight, it seems that *P. semisulcatus* also has two spawning peaks. The stonger one takes place in the early spring (May or even earlier) and summer months (June to August), while the second, highly weaker one occurs between October and November. Hence, mature female broodstock of *P. semisulcatus* can be obtained from Yumurtalık Bight in high numbers in the early spring and summer months at water depths of 20-30 m. Bayhan (7) states that mature *P. semisulcatus* females can be caught at almost every month of the year from deeper waters in North-eastern Mediterranean. Thus, it may be also be possible to obtain mature spawners off the Yumurtalık Bight at any month of the year.

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