A 70-YEAR LONG LESSEPSIAN COLONIZATION: THE CONQUEST OF MALTA BY *AMPHISTEGINA LOBIFERA*

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Abstract
The highly invasive *Amphistegina lobifera* (Larsen, 1976), a non-indigenous benthic foraminifera coming from the Red Sea through the Suez Canal, has colonized the Eastern Mediterranean during the last decades and in 2006 it was recorded for the first time from the Maltese Islands (Central Mediterranean). Here, we report new data from a sediment core collected in May 2018 near the northern coast of Malta. Results show that *A. lobifera* reached Malta between 1950 and 1955; then it progressively increased in abundance with time, probably favoured by the rising of Mediterranean SST during the last 40 years.

Keywords: Alien species, Foraminifera, Lessepsian migrants, Mediterranean Sea

Introduction
The Indo-Pacific foraminifera *Amphistegina lobifera* was observed for the first time in the Maltese Islands in 2006 [1]. However, its real first occurrence in the area is still unknown. This study aims to date the first occurrence of *A. lobifera* in Malta through a ^{210}Pb-dated sediment core. Additionally, the history of its invasion is also reconstructed, taking into account the SST trends reported from the western Mediterranean region.

Material and Methods
On 8th May 2018, one sediment core was collected at 16 m depth in Marsamxett Harbour, Malta (Lat. 35°54'16.7''N; Long. 14°30'27.5''E). The core, 41 cm long and mostly composed of fine-grained sediments, was longitudinally sectioned in two halves and then crosscut into 41 samples, each of them being 1 cm thick. Samples were prepared for both micropaleontological and radiometric analyses (^{210}Pb decay). Sediment samples were dried, weighed (about 7 grams) and then washed on a 63 mm sieve. Washed residues were analysed at the stereomicroscope, in order to calculate, along the core record, the absolute abundance of *A. lobifera* as number of individuals recorded per gram of dry sediment (N g^{-1}). ^{210}Pb activity ($t_{1/2}$ = 22.3 years) was measured via alpha counting of its daughter isotope ^{210}Po, assuming secular equilibrium between the two isotopes. Sedimentation rates for the last decades were calculated based on the decreasing concentration of excess ^{210}Pb, following the Constant Flux – Constant Sedimentation model [2].

Results and Discussion
Amphistegina lobifera is continuously present from cm 0-1 below the sea floor (bsf) to cm 14-15 bsf, with a characteristic decreasing abundance trend going back in time (Fig. 1). It is highly abundant (from 3.95 to 1.11 N g^{-1}) in the upper part of the core down to cm 6-7 bsf, and then it abruptly decreases in abundance down to cm 14-15 bsf, where its lowest occurrence is recorded (0.28 N g^{-1}).
The ^{210}Pb activity is detected through the typical activity-depth profile, showing higher concentration at the core top that rapidly decreases down to the bottom. The derived age model shows a constant sediment accumulation rate (SAR) of about 0.22 cm yr^{-1}, hence constraining the studied record chronologically. According to this model, each centimetre of sediment corresponds to a time interval of about 5 years.
The combination of micropaleontological and radiometric analyses shows that the first occurrence of *A. lobifera* in Malta can be backdated to A.D. 1950-1955, sixty years earlier than its first finding in 2006 (Fig. 1). During the first two decades (1955 to 1975), it is present with very low abundances, probably in response to environmental conditions still not completely favourable for the growth of dense populations. Starting from the 1980s, its abundance shows a first increase, followed by a second more rapid increase in the mid-1990s (Fig. 1). The maximum peak of abundance is recorded at cm 3 bsf, corresponding to A.D. 2006, the same year when the species was first recorded in four different sites in Malta, Comino and Gozo [1]. The increased abundance of *A. lobifera* (Fig. 1), especially since the 1980s, perfectly mirrors the Sea Surface Temperature (SST) increasing trend registered in the Western Mediterranean [3]. This result supports the assumptions of geographical distribution models of *A. lobifera* [4].

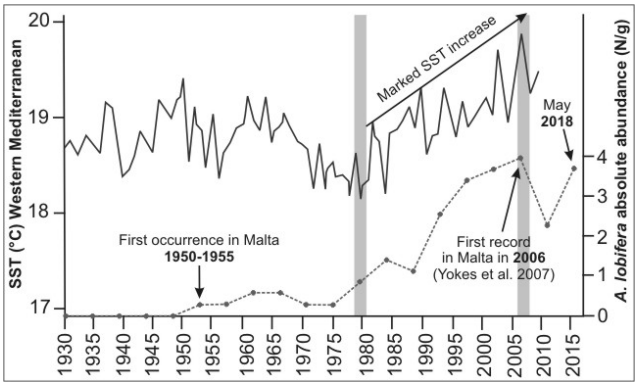

Fig. 1. Absolute abundance of *A. lobifera* plotted against the SST of the Western Mediterranean during the last century (modified after [3]).

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