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THE IMPORTANCE OF *POSIDONIA OCEANICA* MEADOWS TO THE DISTRIBUTION OF *PINNA NOBILIS* THROUGH HABITAT SUITABILITY MODELLING

Abstract
Pinna nobilis is endemic to the Mediterranean and the region's largest marine bivalve whose endangered status has been linked to habitat loss. In particular P. oceanica meadows play a key role in modifying the landscape to create habitats for many associated species including Pinna nobilis. Snorkel surveys assessed population numbers within the first 0.5 m – 5 m depth of eleven sites around the Greek island of Lipsi in the Eastern Aegean, Greece. Habitat Suitability Modelling was used to predict location using Posidonia oceanica meadows and bathymetric data as predictors. Results indicated a significant association between P. oceanica and P. nobilis within the first 0.5 m – 5 m. This study fills a gap in knowledge of P. nobilis distribution and is of particular relevance after the mass mortality event now linked to the Haplosporidium pinnae sp. nov., parasite.

Keywords: Marine conservation, Greece, mollusc, MaxEnt.

Introduction
Destruction and fragmentation of habitat is one of the key drivers of global biodiversity loss (Worm et al., 2006). In the case of *Posidonia oceanica* (L.) meadows, an endemic Mediterranean species, numerous anthropogenic influencers are known to contribute to decline, as well as naturally occurring periods of regression and expansion (Boudouresque et al., 2009). *P. oceanica* meadows are key habitats for many associated species, such species is *Pinna nobilis* (L.), the largest endemic species of marine bivalve in the Mediterranean with anterio posterior lengths of up to 120cm (Rouanet et al., 2015). Prior studies in shallow water marine environments indicated depth and the presence of *Posidonia oceanica* influence distribution (Katsanevakis, 2007, Tsatiris *et al*., 2018), however reports of *P. nobilis* occurring on other substrates are not uncommon (e.g. Katsanevakis & Thessalou-Legaki, 2009; Tsatiris *et al*., 2018).Typically *P. nobilis* studies have been carried out in locations of high population density. This study aimed to assess the importance of habitat factors on *P. nobilis* populations on Lipsi Island in the Dodecanese, eastern Aegean Sea, Greece, where population densities are generally low.

Method
A methodology, as outlined by Katsanevakis, (2007), was adapted to facilitate snorkel surveys, and used to access *P. nobilis* populations across eleven sites. Each transect started at 0.5m depth and finished at 5m with surveys only being conducted when visibility permitted an unrestricted view of the seabed. Depth was determined with a "suunto ZOOP" dive computer. When found, shell width was measured, depth recorded and a GPS point taken (Garmin Etrex). Habitat modelling was performed using "MaxEnt" software (Phillips & Dudík, 2008) with environmental variables of bathymetric data and remotely sensed seagrass presence and absence. *P. nobilis* location data were used as training data for the model.

Results
A total of fifteen *P. nobilis* individuals were located at four different sites around the island. Three were omitted from the study as species verification was not possible due to small size.

Individuals considered to be mature enough to identify as *P. nobilis* had shells with a width greater than 10cm. The majority of *P. nobilis* found were located between two bays, six in the west and five to the south east, only one other was located to the south of Lipsi. The MaxEnt model ran with cross validation and five replicates to help mitigate the impact of small sample size. Strong model performance (Mean AUC = 0.906) and reliability were shown (Fig. 1) with jackknife testing indicating *P. oceanica* presence (0.68) as having the highest test gain in comparison to depth (0.64). However, depth as a variable did show greater permutation importance (64.3%) to towards the model compared to seagrass (35.7%).

Discussion

A strong association between *P. nobilis* location and *P. oceanica* presence was predicted by the model. Despite also appearing significant, depth as a predictor must be treated with caution due to the surveys being conducted within a narrow depth range. We suggest two hypotheses for the strong association between *P. nobilis* and *P. oceanica.* One hypothesis is that, where coastal conditions do not promote strong recruitment of *P. nobilis*, the conditions within *P. oceanica* beds are favourable enough to allow limited recruitment. Alternatively, P. nobilis are more cryptic within *P. oceanica* beds and therefore less likely to be impacted by anthropogenic factors. Lipsi relies heavily on fishing and tourism for economic stability, both of which may be impacting *P. nobilis* numbers; fishing practices are poorly regulated whilst *P. nobilis* are illegally fished for food while shells are used as decoration. It is noteworthy that the two sites with the highest *P. nobilis* numbers were infrequently visited by the public.

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