Habitat suitability of the squid *Sthenoteuthis oualaniensis* in northern Indian Ocean based on different weights

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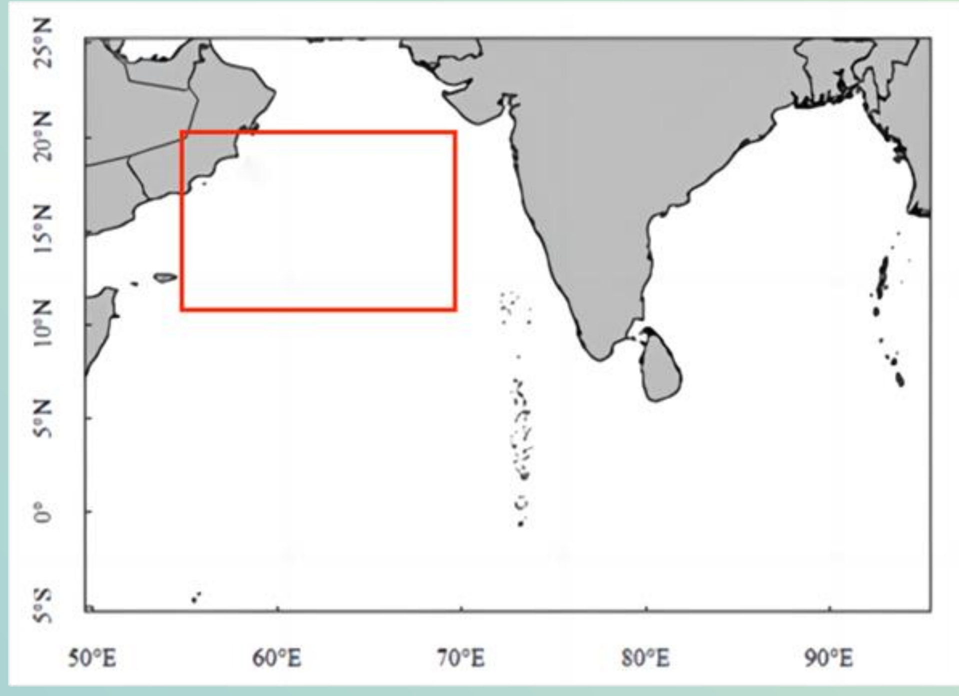
Background

Sthenoteuthis oualaniensis is widely distributed in the Indian Ocean, as well as the tropical and subtropical maritime areas of the Pacific, particularly in the northwest waters of the Indian Ocean and the south China sea . The habitat suitability index (HSI) is widely used in population distribution and fishing ground forecasts in recent years, describing the habitat characteristics of species under varying environmental conditions. HSI is one of the main means for presenting spatial distribution of fish resources in the marine environment. The relationship between the habitat of *S.oualaniensis* and environmental variables was here studied and analyzed, with the aim of providing a scientific basis for forecast and management of *S.oualaniensis* resources.

Material Source

The fishing ground analyzed in this study was mainly distributed in the waters be-tween 10° N~20° N and 55° E~70° E in the northern Indian Ocean. The collected data included: date, longitude, latitude and the total catch. According to the results of previous studies, the marine environmental factors that mainly affect the habitat distribution of *S.oualaniensis* in the Indian Ocean are SST, wind speed (WS), and PAR.



Materials and methods

Calculation

$$CPUE=\frac{C}{E}$$

SI model

$$SI=\frac{CPUE_i-CPUE_{i,min}}{CPUE_{i,max}-CPUE_{i,min}}$$

$$SI_X=\exp[a\times(X-b)^2]$$

HIS model

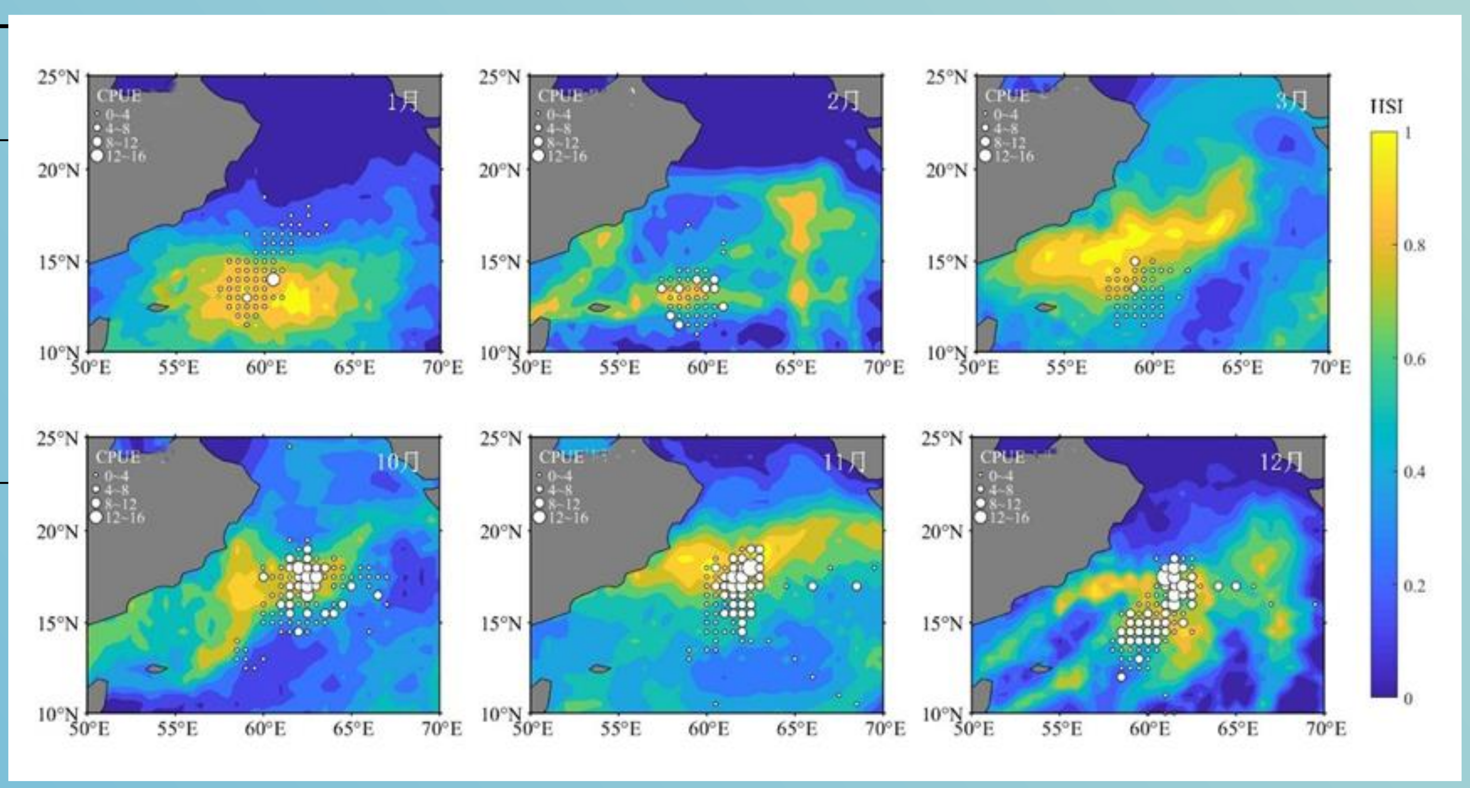
$$HSI=k_{SST}\times SI_{SST}+k_{WS}\times SI_{WS}+k_{PAR}\times SI_{PAR}$$

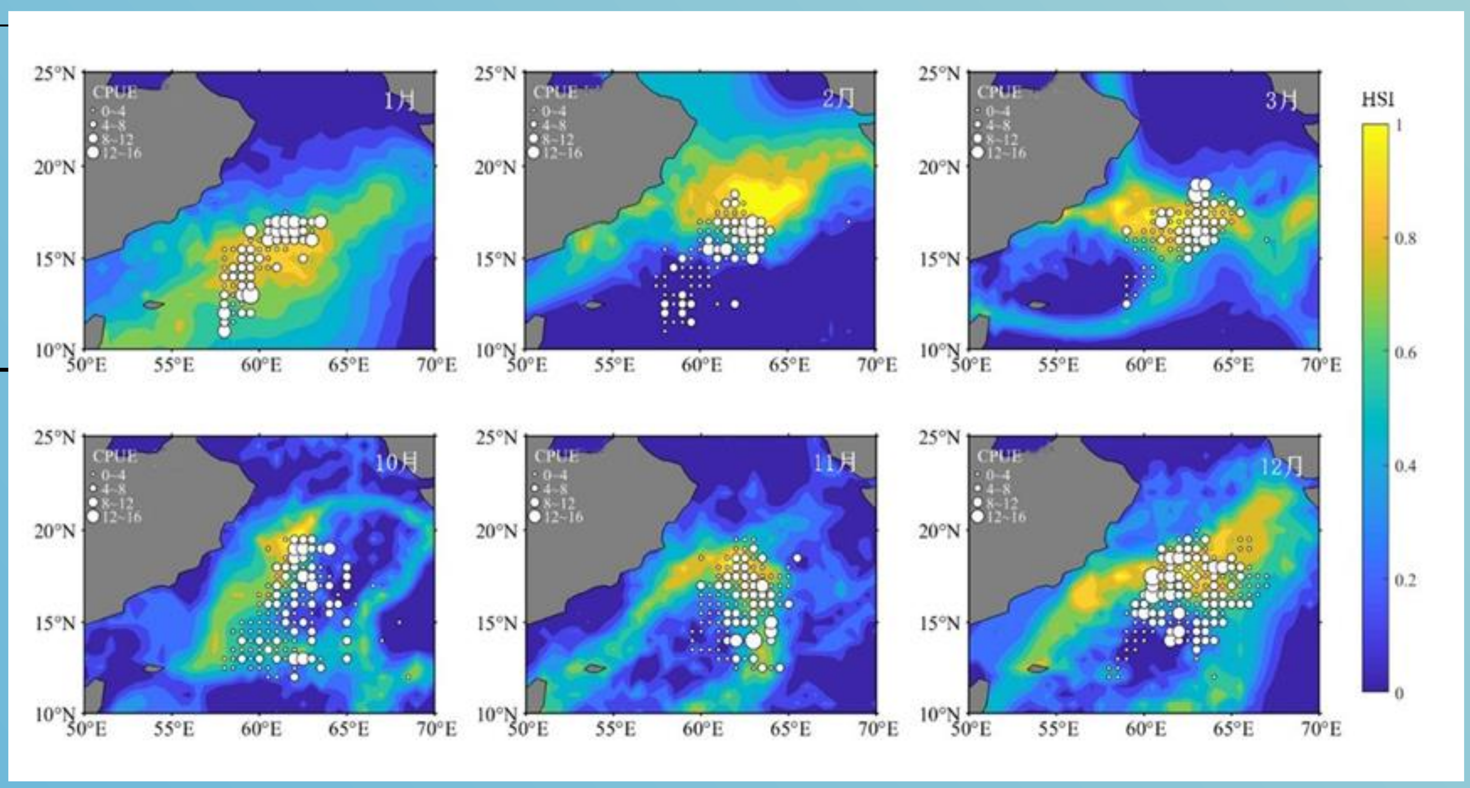
HSI model screening and verification

By comprehensively comparing the proportion of yield and fishing effort, the CPUE value, and the optimal weight scheme was selected to obtain the optimal HSI model.

Results

Environmental factors	Month	SI model	R^2	P
SST	January	$SI_{SST}=\exp[-4.012\times(X_{SST}-25.877)^2]$	0.981	0.006
	February	$SI_{SST}=\exp[-7.845\times(X_{SST}-25.498)^2]$	0.982	0.001
	March	$SI_{SST}=\exp[-11.417\times(X_{SST}-26.756)^2]$	0.999	0.008
	October	$SI_{SST}=\exp[-4.696\times(X_{SST}-28.089)^2]$	0.997	0.001
	November	$SI_{SST}=\exp[-7.814\times(X_{SST}-27.889)^2]$	0.760	0.018
	December	$SI_{SST}=\exp[-6.75\times(X_{SST}-26.459)^2]$	0.925	0.001
WS	January	$SI_{WS}=\exp[-0.919\times(X_{WS}-6.926)^2]$	0.747	0.001
	February	$SI_{WS}=\exp[-14.23\times(X_{WS}-5.229)^2]$	0.549	0.005
	March	$SI_{WS}=\exp[-1.896\times(X_{WS}-4.035)^2]$	0.689	0.031
	October	$SI_{WS}=\exp[-9.212\times(X_{WS}-3.264)^2]$	0.955	0.001
	November	$SI_{WS}=\exp[-1.029\times(X_{WS}-4.987)^2]$	0.623	0.017
	December	$SI_{WS}=\exp[-4.895\times(X_{WS}-7.45)^2]$	0.826	0.016
PAR	January	$SI_{PAR}=\exp[-0.564\times(X_{PAR}-43.059)^2]$	0.742	0.003
	February	$SI_{PAR}=\exp[-0.501\times(X_{PAR}-48.204)^2]$	0.536	0.009
	March	$SI_{PAR}=\exp[-1.061\times(X_{PAR}-54.238)^2]$	0.814	0.001
	October	$SI_{PAR}=\exp[-6.686\times(X_{PAR}-47.041)^2]$	0.756	0.001
	November	$SI_{PAR}=\exp[-0.547\times(X_{PAR}-41.682)^2]$	0.733	0.001
	December	$SI_{PAR}=\exp[-1.552\times(X_{PAR}-39.563)^2]$	0.613	0.001





Up: The spatial distribution of CPUE overlapped with the HSI values in 2017–2018.
Below: The spatial distribution of CPUE overlapped with the HSI values from 2019, calculated by the optimal model.

Conclusions

This study selected three environmental factors, SST, WS, and PAR, to construct an HSI model. However, in the actual growth environment of *S.oualaniensis*, it is also affected by various other environmental factors. A more comprehensive analysis of the impact of each environmental factor on the habitat is needed to make the HSI model more accurate. In the future, it is necessary to strengthen the collection of time series samples, improve the quality of fishing data, comprehensively consider more environmental factors and climate events, accurately analyze the changes in the fishing grounds and habitats, which could provide a basis for the rational development of the fishery and the establishment of relevant fishing situation prediction models.