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Quantitative studies on the stock assessment and management strategy evaluation for the common spiny lobster *Palinurus elephas* in Tunisia

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博士学位論文内容要旨
Abstract

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論文題目 Title	Quantitative studies on the stock assessment and management strategy evaluation for the common spiny lobster <i>Palinurus elephas</i> in Tunisia (チュニジアのヨーロッパイセエビに対する資源評価と資源管理方策評価法に関する数量的研究)		

The common spiny lobster (*Palinurus elephas*) is one of the most valuable species in the Mediterranean and in Tunisia. Given its importance, this species has been exploited for a long time in Tunisian water and the stock is considered overfished despite the current applied management regulations. The lack of data is one of the challenges related to applying the appropriate stock assessment method and managing this stock. In this research, we aim to assess and develop management procedures for the common spiny lobster stock in Tunisia. To explore the stock status, we used data-limited and data-moderate assessment methods. We then evaluated model-based management procedures within a management strategy evaluation framework.

In the first chapter of this thesis, we introduced the background of the common spiny lobster biology, the fishery, and its management in Tunisia. The second chapter of this thesis focused on the applying the data-limited methods when only catch data are available in the first place and then when fitting the abundance index data. We used a catch-only method, CMSY, and state-space Bayesian surplus production model, BSPM. The CMSY method required catch time-series and prior information about the stock status and the resilience of the species to estimate fishery's reference points and the biomass. The BSPM was fitted to time series of catch and commercial catch per unit effort (CPUE) data. Sensitivity analysis to evaluate the sensitivity of the models to changes in the models' parameters has also been carried out. The results of the assessments showed that with the current specifications, the common spiny lobster stock is depleted and highlighted the sensitivity of catch-only methods to prior ranges of the models' parameters, especially the final depletion. In the third chapter, we focused on applying a data-moderate assessment method, the state-space delay-difference method, DDM, and how it may contribute to the stock assessment and management of this species. This method showed that the stock is highly depleted and highlighted the importance of understanding the recruitment process in the population dynamic of the common spiny lobster. In the fourth chapter, the delay-difference model explored in the previous chapter was used for the conditioning of the operating model within the Management Strategy Evaluation (MSE) framework. The MSE is applied to evaluate the performance of ten model-based management procedures (MPs) ranging from conservative, moderate to relaxed management procedures, depending on the defined control points, to achieve the conservation and catch performance objectives for the common spiny lobster fishery in Tunisia. The surplus production model was used as an assessment model in the management procedure to inform the harvest control rule and set the total allowable catch. The advice regarding the best management strategy is based on the analysis and comparison of a set of performance metrics that were defined to quantify the management objectives. The conservation objectives are ensured by maintaining the biomass above certain target biomass and preventing the biomass from dropping below a biomass limit. The catch performance management goals are provided by maximizing the catch and maintaining its stability over the years. The application of the MSE showed that that model-based management procedure could perform well and achieve the objectives proposed to the conservation of the common spiny

lobster stock in Tunisia in most of the scenarios. The simplicity of the assessment model, and the low requirement in data have allowed to implement and evaluate the quota management for the lobster stock in this study. We found that the conservative management strategies performed well in terms of management objectives but yielded in the lowest catches, while relaxed management strategies could not achieve the management objectives. Moderate management strategies performed well in balancing the trade-off between the conservation and the catch performance objectives.