

The Schaeffer production model for the setting of operational objectives: an example from Sardinia

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Adaptive management plan



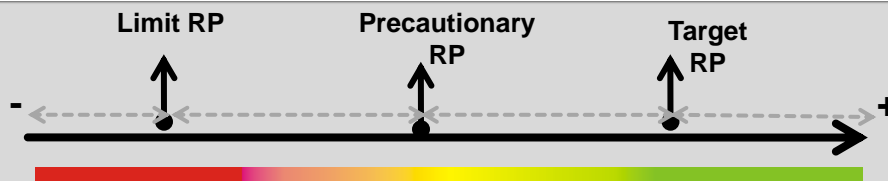
IN A MANAGEMENT PLAN

- Firstly, goals and management objectives must be specified.
- Fishery management has three main **goals**: sustain the stock, sustain the fishery, and sustain the employment
- Management **objectives** must provide a direction for management action

To measure the performance of management in achieving the objectives, "**indicators**" and "**reference points**" must be included.

- Indicators** show the state of the fishery
- Reference points** (RP) are particular values of indicators that show the states you would like to achieve or avoid (Limit and Target reference points)

Adaptive management plan



Reference points:

Target reference point (TRP), corresponding to a situation considered as desirable and to be achieved on average;

Limit reference point (LRP), indicating a situation that is undesirable and to be avoided at all costs;

Precautionary reference point (PaRP): providing a threshold at which initial actions can be taken to reduce the risk that the limit may be broken.

Adaptive management plan

All reference points should be agreed with stakeholders in advance and used to trigger specific conservation and management actions, also agreed in advance and formalized in **decision rules**

Decision rules: define in advance what the management action will be taken, depending on the position of the indicator relevant to the reference point

Decision control rule	
$(X_{\text{now}} \leq X_{\text{Xve}})$	No action
$(X_{\text{ve}} < X_{\text{now}} < X_{\text{pa}})$	Recommend catch control at the national level
$(X_{\text{pa}} \leq X_{\text{now}} < X_{\text{lim}})$	Recommend catch control at the national level Surveys to evaluate the actual biomass
$(X_{\text{now}} \leq X_{\text{lim}})$	Recommend stricter catch control at the national level Surveys to evaluate the actual biomass Evaluate the possibility to close the fishing

Adaptive management plan



According to FAO (2009) the type of data available permit to identify three main different starting situations (type of indicators), leading to different approaches to be implemented when planning the management of a given resource.

CASE A – no data/poor data

(No knowledge other than qualitative data from markets)

Case B – medium data

(Short- or long-term catch data. Length by year data. No effort data. No local biological studies)

Case C – rich data

(Species-specific length data, short- or long-term landings and fishing effort data by year by major fishing sectors, biological studies conducted on few major species. Little ecological information)

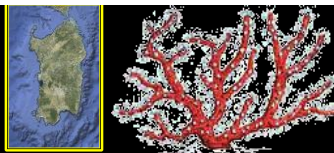
Adaptive management plan

Data needs for selected methods for estimating different fishery indicators

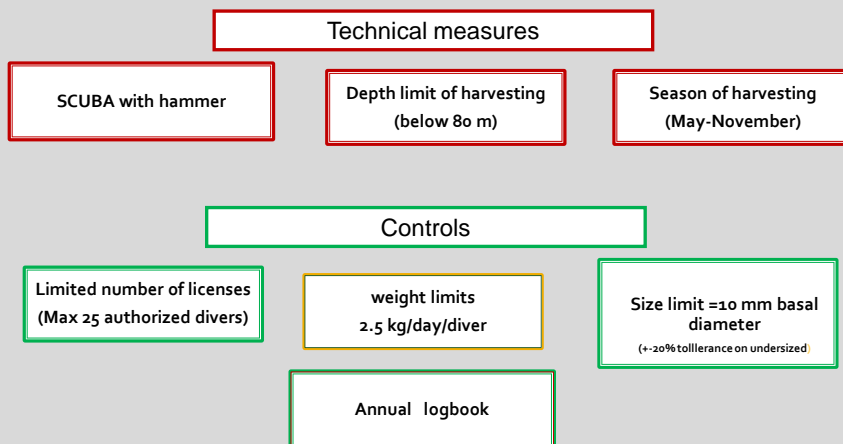
Data					Reference points	
Catch	Effort	Length freq.	Age freq.	Intermediate parameters	Method	Indicators
MyrTS		1 yrTS				$Y_{t0}; Y_{lim}$ $S_{t0}; S_{lim}$
			SS	Growth M Size-weight relationship	Analytic model : Yield per recruits(Y/R) Beverthon and Holt (1957)	$A_{t0}; A_{lim}$
MyrTS	MyrTS				Production models (Schaeffer model (1957); Fox model (1970); Pella and Tomlinson(1969)	$B_{0y}; B_{msy}$

Myr: Multiyear; TS: time series of data; SS: single sample

Management measures in Sardinia



In the last 30 years, Sardinian Administration has established some regulations to allow responsible exploitation of discovered red coral banks within its waters.



The Schaeffer production model

Characteristics of the model

- ✓ The Schaeffer model is an holistic model wherein the stock is considered as one big unit of biomass and wherein no attempt is made to model on age or length base.
- ✓ The objective of the model is to determine the **optimum level of effort**, i.e the effort that produces the maximum yield that can be sustained without affecting the long term productivity of the stock (MSY)

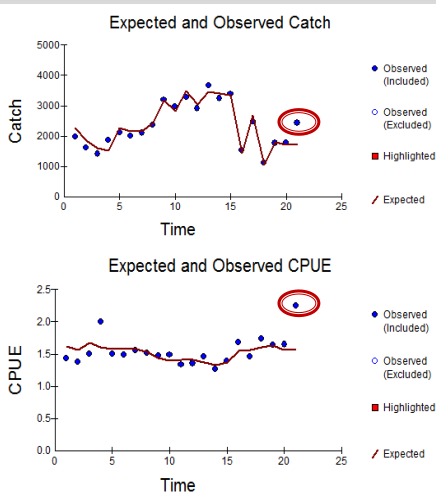
The Schaeffer production model

Theory of the model

- ❖ The model is based on the principle that the total biomass of a stock can increase until a value, called *carrying capacity* K , following a *growth rate* r , that will be small when the biomass is scarce, increases when the biomass grows and reduces when approaches the carrying capacity.
- ❖ The changes of the biomass could be influenced by the natural fluctuations but in any case its tendency must always be to an increase in the *carrying capacity* K
- ❖ Obviously, in exploited stock the growth rate r is influenced both by natural fluctuations and **harvesting**

It is IMPORTANT to consider the influence of the harvesting in EXPLOITED STOCK!

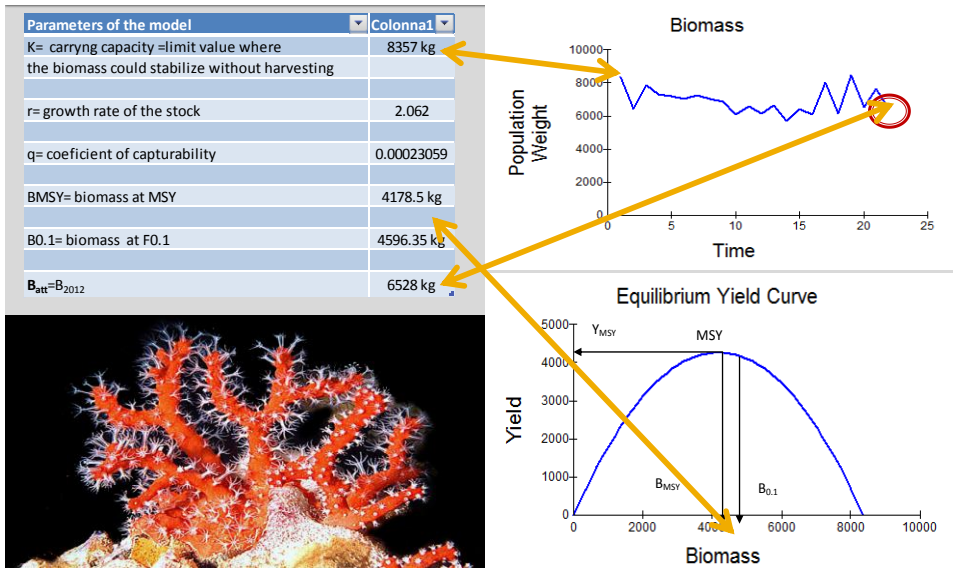
The Schaeffer production model Results



1990 - 2012

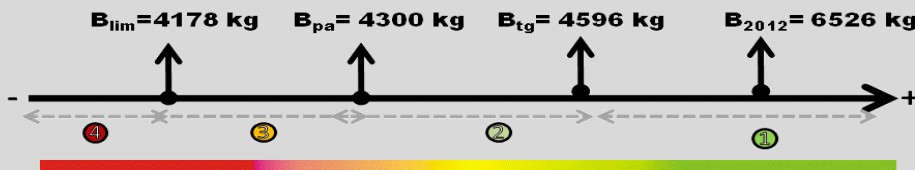


The Schaeffer production model Results



Operational objectives

GOAL	OBJECTIVE	INDICATOR	REFERENCE POINTS	Precautionary RP
TO KEEP RED CORAL HARVESTING AT A SUSTAINABLE LEVEL	Maintain the biomass at Maximum Sustainable Yield (MSY) level	BIOMASS= B (Schaeffer Production model)	Target= B _{tg} =B _{0.1} Limit=B _{lim} = B _{msy}	Threshold= B _{pa} =B _{tg} =B _{0.1} > X



Decision control rule		
1	(B ₂₀₁₂ ≥ B _{tg})	No action
2	(B _{pa} < B ₂₀₁₂ < B _{tg})	Recommend stricter controls or a small reduction W of the effort
3	(B _{lim} < B ₂₀₁₂ < B _{tg})	Recommend stricter controls or a medium reduction Y of the effort
4	(B ₂₀₁₂ < B _{lim})	Recommend stricter controls at the national level i.e a strong reduction Y of the effort or evaluate the possibility to close the fishing

Conclusions and Recommendations

- ✓ The surplus production model is based on the capture and effort data certificated by the fishermen; The values could be underestimated and consequently the gap between B_{2012} and B_{tg} could be smaller.
- ✓ In any case, the B_{2012} appeared lower than the values registered in the 1990s and that of the carrying capacity. It must be considered a sign of suffering of the red coral stock.
- ✓ Even if for a more complete and real assessment of the condition of the stock, the production model results must be considered together with those derived from analytical models, these preliminary results can confirm that **in Sardinian seas the fishing effort on red coral should not be increased during the next years of management**

