Will the Mediterranean monk seal (*Monachus monachus* Hermann, 1779) in the Northeastern Mediterranean become extinct in the future?

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INTRODUCTION

The northeastern Mediterranean coast of Turkey is one of the last remaining refuges where the critically endangered Mediterranean monk seal still survives and reproduces. Status of this colony has been closely monitored since 1994 by METU-IMS. One of the most significant threats in the region was proved to be over-exploitation, and thus, reduction of the fish stocks (Gucu et al, 2004). Therefore, a large area (16x12 nautical miles) was prohibited to large-scale fishery by Turkish Ministry of Agriculture and Rural Affairs since 1999. Moreover, a network of small no-fish-zones was set in front of the breeding caves. In this study, the vital parameters of the monk seal colony, obtained since 1994, were evaluated using population viability analysis (PVA) to estimate the risk of further decline of this species in the northeastern Mediterranean, and their expected chances of recovery. The three main questions to be answered were: i) what are the positive and negative implications of conservation measures applied in the area on the colony's demography? ii) What are the potential risks awaiting the colony in the future? iii) Is there a need to change or revise the existing conservation strategy?

MATERIAL & METHODS

Demographic changes in the colony was evaluated by comparing the effect of Marine Protected Area established in 1999 as pre-conservation and post-conservation phases and Ramas Ecolab (Akcakaya and Root, 1998) was used to conduct age structured PVA of the monk seal colony.
The demographic structure estimated in 1994 was updated with the number of dead seals and newborn pups found in every proceeding calendar year (Table 1).
The model was age structured including 7 age classes and the main model parameters were survival and fecundity rates
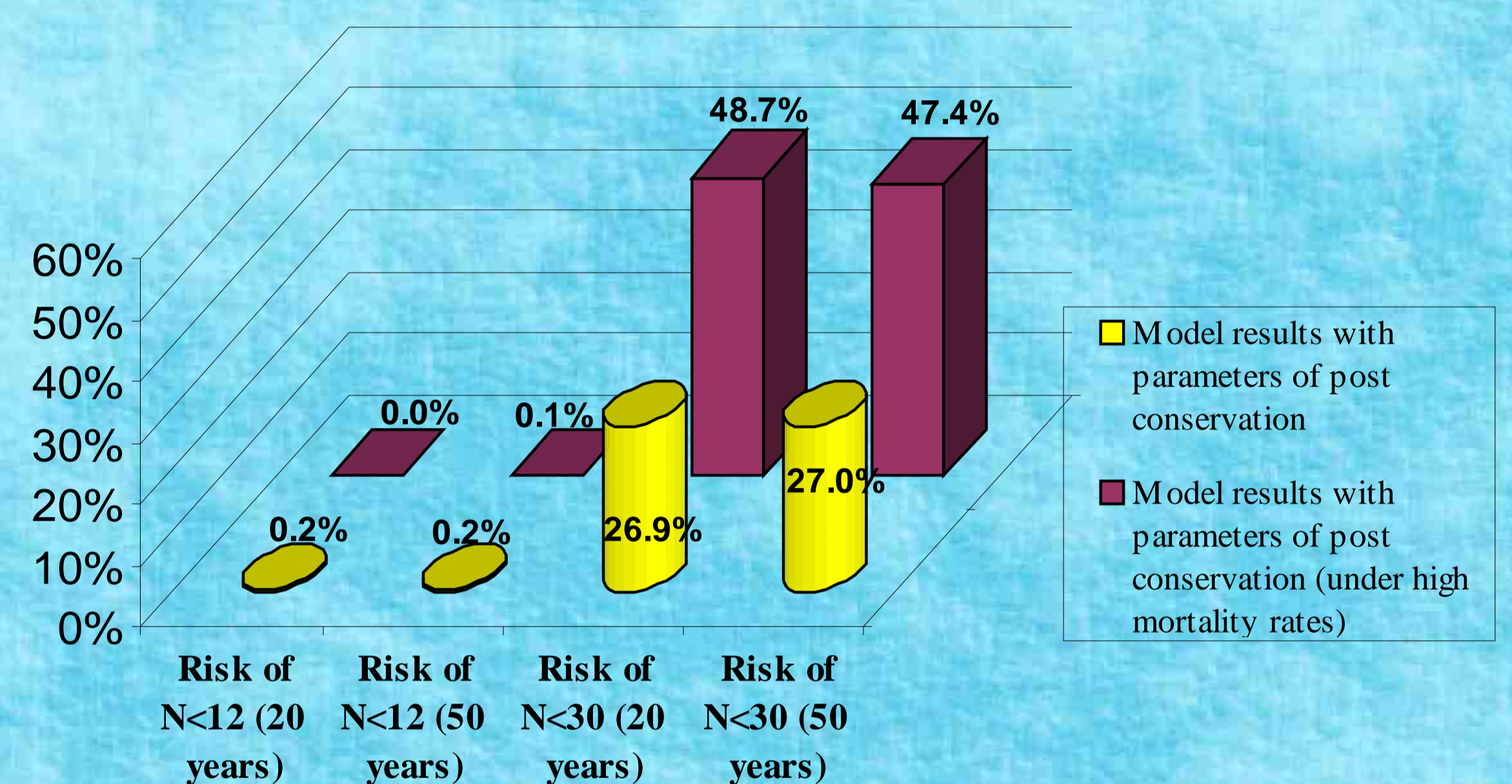The model scenarios were:
1. No change: current conditions continue to foresee the next 20 and 50 years of the colony.
2. Increased mortality of individuals due to presence of as many unrecorded deaths as recorded deaths.
3. Decreased survival and fecundity of individuals in case of protection is removed (pre-conservation).
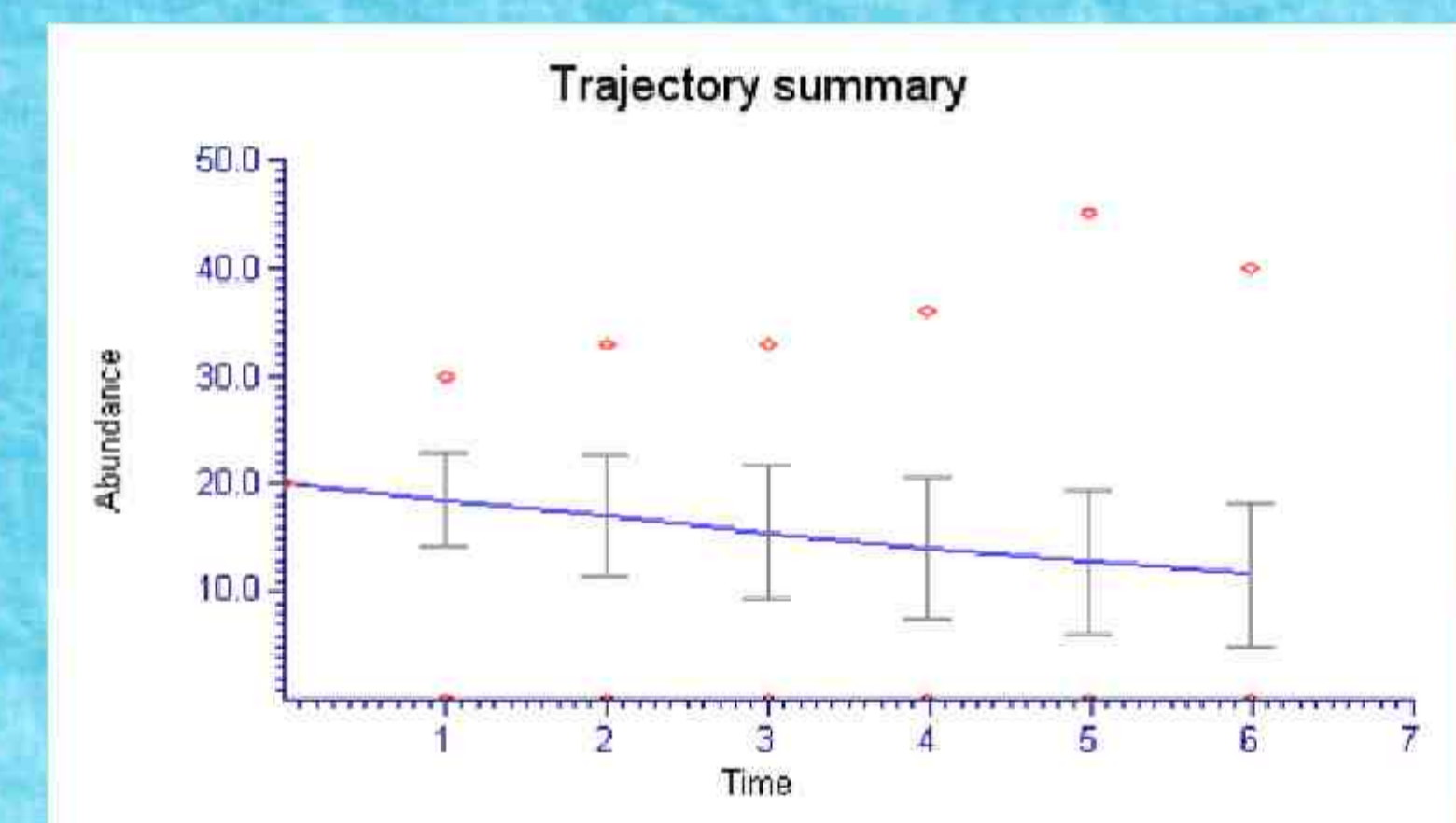4. Increased mortality in early life stages.

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Table 1: Identified Cilician colony members with their estimated minimum ages (based on Gucu et al., 2004).
† : the monk seal that found or reported as death from 1994 to 2005.
* : Back projected individuals.

Sex	Name/Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
F	Tekin †	17.38*	18.38*	19.38*	20.38*	21.38	22.38	23.38	24.38	25.38	26.38	27.39	28.39
M	Yula †	9.38	†										
F	Kokona	8.38*	9.38	10.38	11.38	12.38	13.38	14.38	15.38	16.38	17.38	18.39	19.39
F	Kır †	8.38	†										
F	Dede †	8.38	†										
F	Meryem	7.38*	8.38*	9.38	10.38	11.38	12.38	13.38	14.38	15.38	16.38	17.39	18.39
M	Kamash	7.38*	8.38*	9.38*	10.38	11.38	12.38	13.38	14.38	15.38	16.38	17.39	18.39
M	Bombacı	7.38*	8.38	9.38	10.38	11.38	12.38	13.38	14.38	15.38	16.38	17.39	18.39
M	Japon †	7.38	†										
M	Cecan †	7.38	†										
F	Yasli	6.38*	7.38*	8.38	9.38	10.38	11.38	12.38	13.38	14.38	15.38	16.39	17.39
M	Yagiz	5.38*	6.38*	7.38	8.38	9.38	10.38	11.38	12.38	13.38	14.38	15.39	16.39
F	Bozzy †	5.38*	6.38*	7.38	8.38	†							
F	Anac	4.38*	5.38*	6.38*	7.38*	8.38	9.38	10.38	11.38	12.38	13.38	14.39	15.39
M	Yakisikli	3.38*	4.38*	5.38*	6.38*	7.38	8.38	9.38	10.38	11.38	12.38	13.39	14.39
F	Melek†	3.38*	4.38*	5.38*	6.38*	7.38	8.38	9.38	10.38	11.38	12.38	13.39	14.39
F	Meltem	2.38*	3.38*	4.38*	5.38*	6.38*	7.38	8.38	9.38	10.38	11.38	12.39	13.39
F	Charlie †	0.66	†										
F	Ceren		0.44	1.45	2.45	3.45	4.45	5.45	6.45	7.45	8.45	9.45	10.45
F	Ümit †		0.38	†									
M	Arap		0.15	1.15	2.15	3.15	4.15	5.15	6.15	7.15	8.15	9.15	
M	Fent Jr.		0.08	1.08	2.08	3.08	4.08	5.08	6.08	7.08	8.09	9.09	
F	Charlie			0.25	1.25	2.25	3.25	4.25	5.25	6.25	7.25	8.25	
M	Askim			0.16	1.16	2.16	3.16	4.16	5.16	6.16	7.16	8.16	
F	Ney				0.38	1.38	2.39	3.39	4.39	5.39	6.39	7.39	
M	Saklıkuzu				0.22	1.22	2.23	3.23	4.23	5.23	6.23	7.23	
F	Sedef					0.21	1.21	2.21	3.21	4.21	5.21	6.21	
F	Sanda					0.19	1.19	2.19	3.19	4.19	5.19	6.19	
M	Yalcin						0.14	1.14	2.14	3.14	4.14	5.14	
M	Uykucu							0.34	1.34	2.34	3.34	4.34	
F	Gelincik							0.34	1.34	2.34	3.34	4.34	
M	Tarcin								0.24	1.24	2.24	3.24	
F	Zeynep †									0.46	†		
F	Lal †									0.24	1.24	†	
M	Atag †										0.26	†	
F	Kay										0.26	1.26	
M	Luigi										0.09	1.09	
F	Rane										0.08	1.08	
M	Levant											0.19	
M	Tahta											0.13	
F	Lamas											0.02	
	# of Adults	11	8	9	11	11	11	12	14	16	18	20	
	# of Pups	1	1	3	2	2	2	1	1	2	5	3	
	# of Immatures	6	4	4	4	5	7	9	9	9	8	7	7
	Total # of Individuals	18	13	16	17	18	20	21	23	24	26	29	30

ID CARD-25
Seal Name: Kay
Sex: Female
Morphology:
Age (Estimated Minimum in 2005): 1.26
Mother: Round Cave Female and Melleç
Date of First sight: 26.09.2004
Category at first sight: P
Present Category: J

Components of PVA

- Identification of the questions
- Data collection, data analyses and parameter estimation

Model structure

Stages determining

Leslie matrix

Building the model
- Leslie matrix
- Other model parameters

Trajectories

Results

RESULTS

O Future of the colony calculated for next 20 and 50 years

Legend:
- Model results with parameters of post conservation
- Model results with parameters of post conservation (under high mortality rates)

Chart values:
- Risk of N<12 (20 years): 0.2% / 0.2%
- Risk of N<12 (50 years): 0.2% / 0.0%
- Risk of N<30 (20 years): 26.9% / 48.7%
- Risk of N<30 (50 years): 27.0% / 47.4%
- (0.1%)

O If there were no conservation measures

- The risk of decline of the colony to 12 individuals would be 22.7% at the year 2005
- There would be 99% risk that the colony abundance would fall below the existent level observed in 2005

Trajectory summary

O If mortality on the early stages keeps increase

- Abundance may go down.
- When the mortality on stage 2 and 3 is doubled the risk of falling below 18 individuals at least once in the next 20 years is 91%
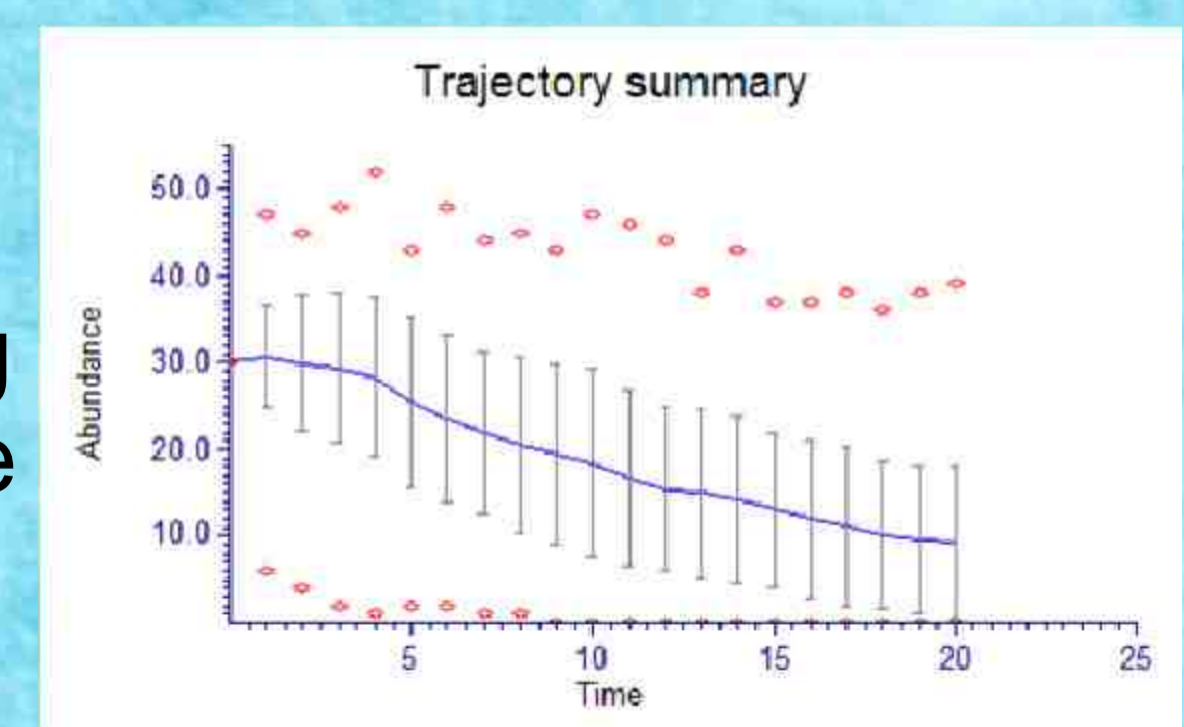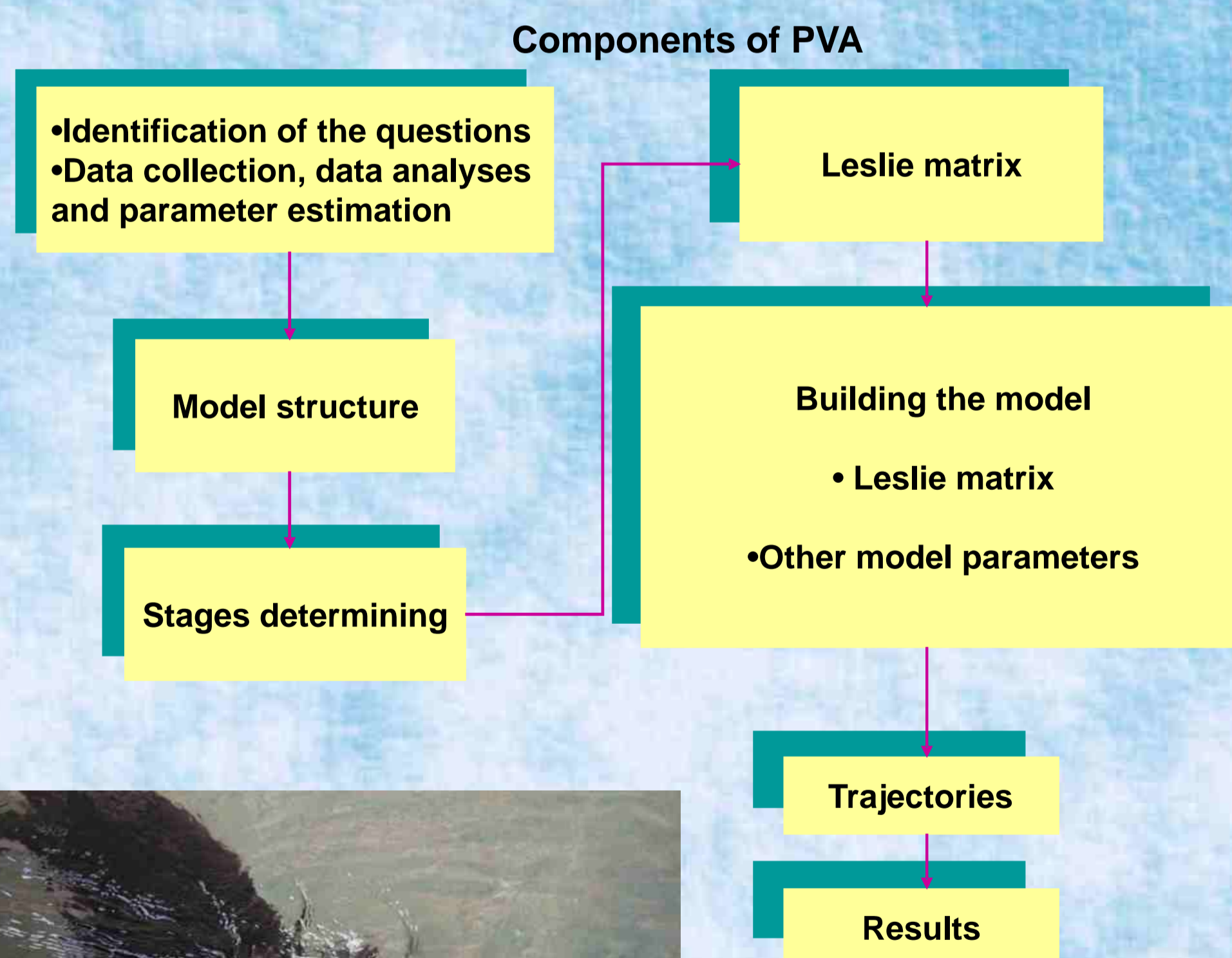

Trajectory summary

CONCLUSION

★ **Existing conservation strategies certainly have a positive effect on the colony's demography**
★ **Considerable risk for the future of the colony remains**
★ **High mortality rates in the early life stages is high risk for the presence and future survival of the colony**
★ **Efforts to reduce such early mortality must be the major priority of the conservation strategies aimed towards the monk seal population**

References
Akcakaya, H. R. and Root, W., 1998. RAMAS EcoLab: Applied Ecology Laboratory.
Gucu, A.C., Gucu, G., Orek H., 2004. Habitat use and preliminary demographic evaluation of the critically endangered Mediterranean monk seal (Monachus monachus) in the Cilician Basin (eastern Mediterranean). Biological Conservation 116 (2004) 417-431.