Advanced Population Modeling : Projections

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Decision Analysis

- We often want to make statements about the consequences of alternative management actions given different states of nature.

Management Action	State of Nature			Expected
	r=0.1	r=0.2	r=0.3	Outcome
Catch=10				
Catch=20	Summary Statistic			
Catch=30				

- To compute expected outcomes we need to know the (relative) probability to associate with each state of nature (more in Bayesian lecture), AND have a way of determining the outcome for each management action.

Decision Tables

- A common steo after a model is fit and evaluated is to generate advice for management based on the assessment results.
- A Decision Table shows these results

(Fay et al. 2005)

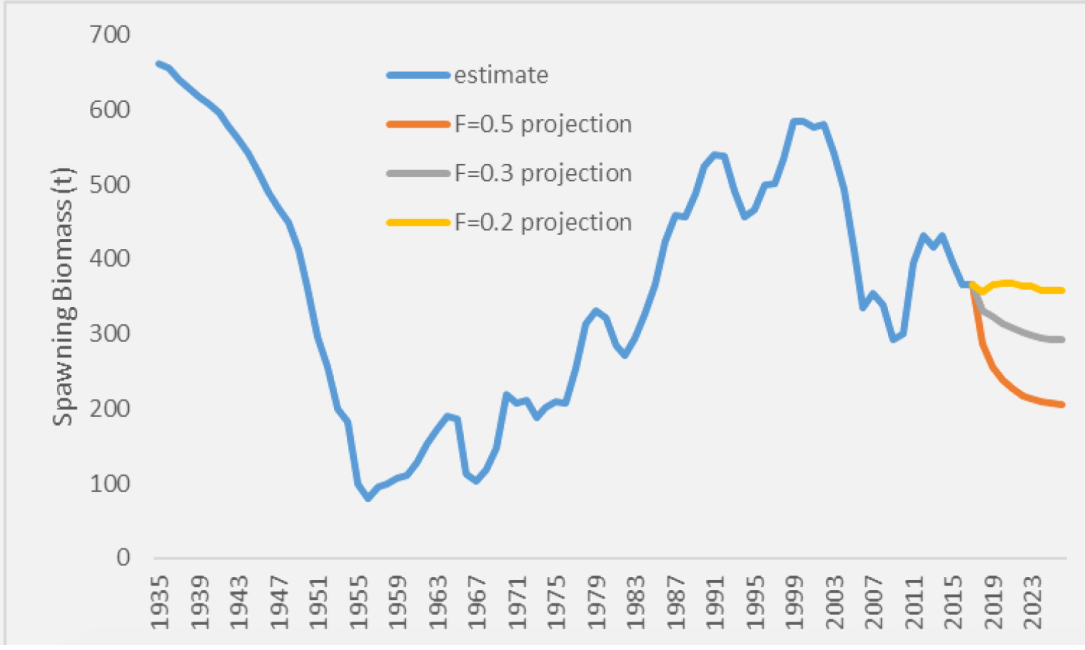
				"Worst" q=1.34 M=0.07		Base q = 1.03 (based on prior) est. M = 0.06		"Best" q=0.79 M=0.05	
Management action	Year	Catch (mt)	Landings (mt)	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
Average of last 5 years	2005	1,640	1,410	50,274	0.64	75,049	0.71	122,513	0.78
	2006	1,640	1,410	49,942	0.64	74,578	0.71	121,828	0.78
	2007	1,640	1,410	49,519	0.63	73,987	0.70	120,997	0.77
	2008	1,640	1,410	49,004	0.63	73,271	0.70	120,009	0.77
	2009	1,640	1,410	48,419	0.62	72,452	0.69	118,886	0.76
	2010	1,640	1,410	47,807	0.61	71,572	0.68	117,677	0.75
	2011	1,640	1,410	47,217	0.60	70,687	0.67	116,443	0.74
	2012	1,640	1,410	46,686	0.60	69,845	0.66	115,244	0.74
	2013	1,640	1,410	46,233	0.59	69,082	0.66	114,125	0.73
	2014	1,640	1,410	45,865	0.59	68,419	0.65	113,115	0.72
	2015	1,640	1,410	45,589	0.58	67,868	0.65	112,233	0.72
	2016	1,640	1,410	45,408	**0.58**	67,437	**0.64**	111,492	**0.71**
OY - F50% for base model	2005	2,838	2,423	50,274	0.64	75,049	0.71	122,982	0.78
	2006	2,831	2,423	49,386	0.63	74,012	0.70	121,722	0.77
	2007	3,953	3,390	48,410	0.62	72,853	0.69	120,308	0.76
	2008	3,859	3,316	46,816	0.60	70,989	0.68	118,185	0.75
	2009	3,765	3,239	45,205	0.58	69,067	0.66	115,965	0.74
	2010	3,671	3,159	43,624	0.56	67,137	0.64	113,700	0.72
	2011	3,576	3,075	42,127	0.54	65,259	0.62	111,460	0.71
	2012	3,482	2,990	40,754	0.52	63,487	0.60	109,309	0.69
	2013	3,391	2,903	39,523	0.51	61,858	0.59	107,292	0.68
	2014	3,304	2,818	38,443	0.49	60,391	0.57	105,440	0.67
	2015	3,224	2,737	37,517	0.48	59,101	0.56	103,773	0.66
	2016	3,154	2,664	36,746	**0.47**	57,990	**0.55**	102,301	**0.65**

Stock projections

- Use the results of the assessment as the basis for the projection, given different assumptions for future conditions
- e.g. catch, F, recruitment, growth, M, etc.
- Projections can be deterministic or stochastic, with varying complexity.

Short-Term Deterministic Projection

- Project stock forward from the last year of the estimation model, assuming either F or catch, and population parameter values from the estimation model

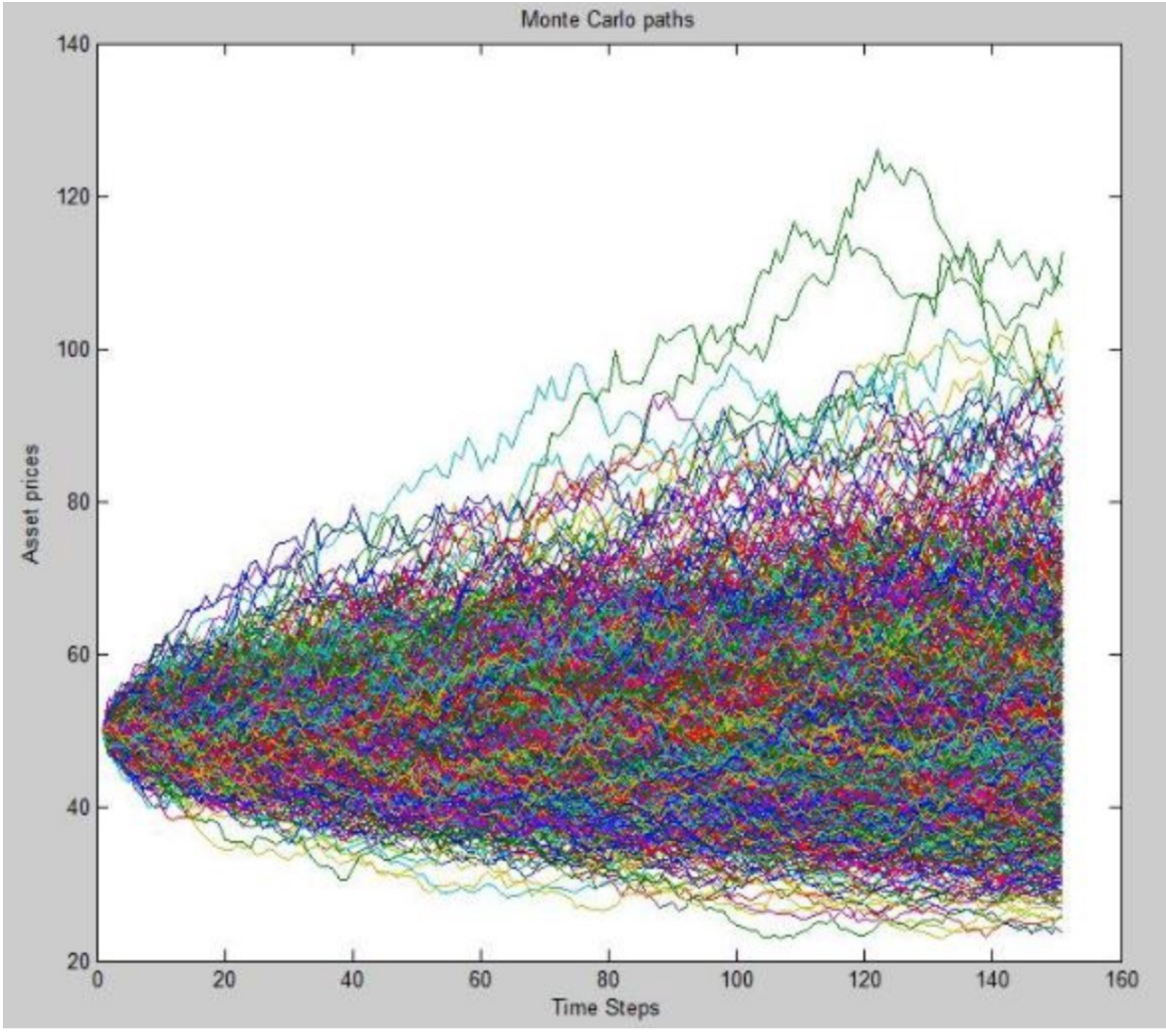


Implementing deterministic projections

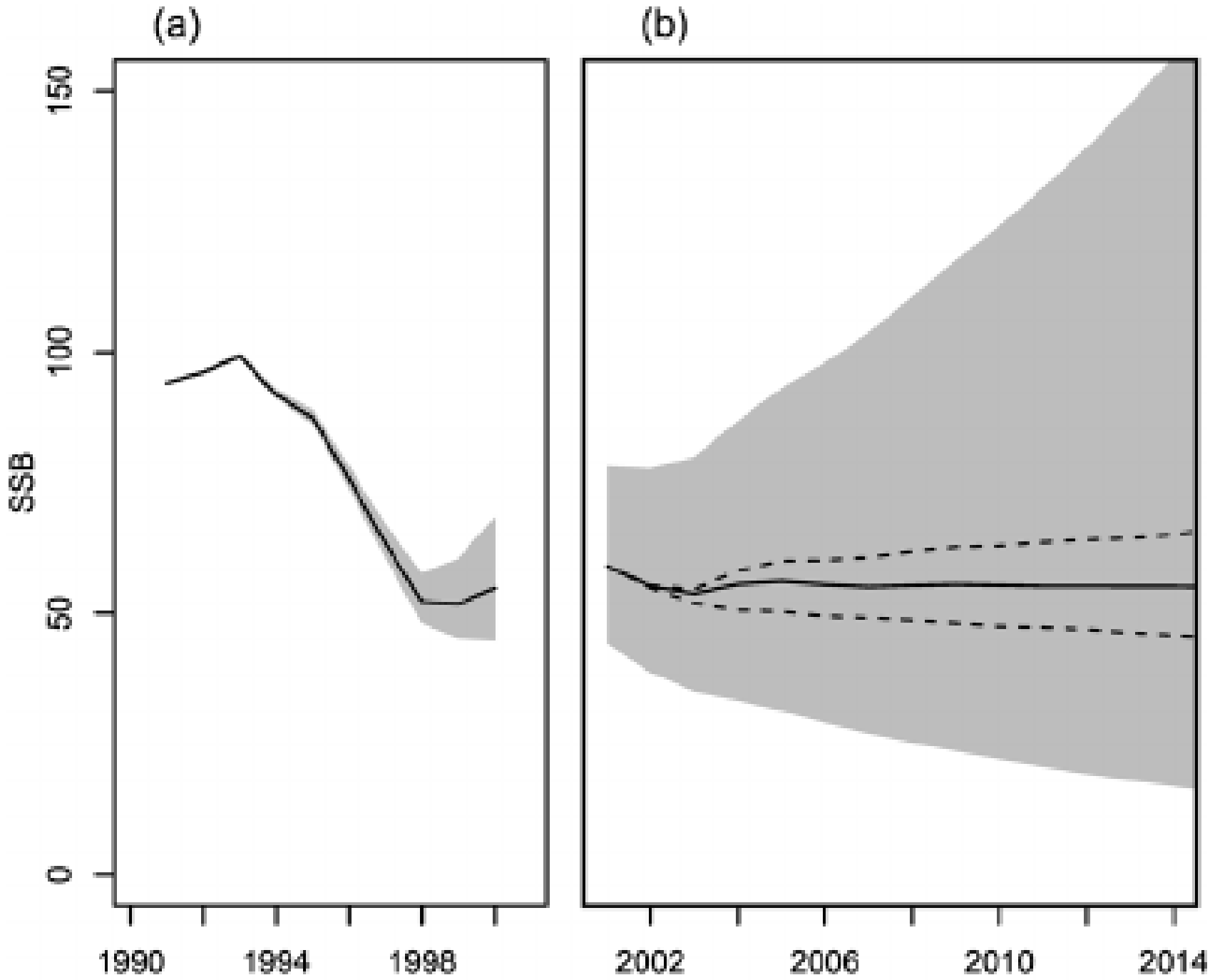
- Extend (or create new) storage objects for state variables
- Input the required catch advice (e.g. F or TAC)
- Loop over the projected years with the calculations for population dynamics

Stochastic projections

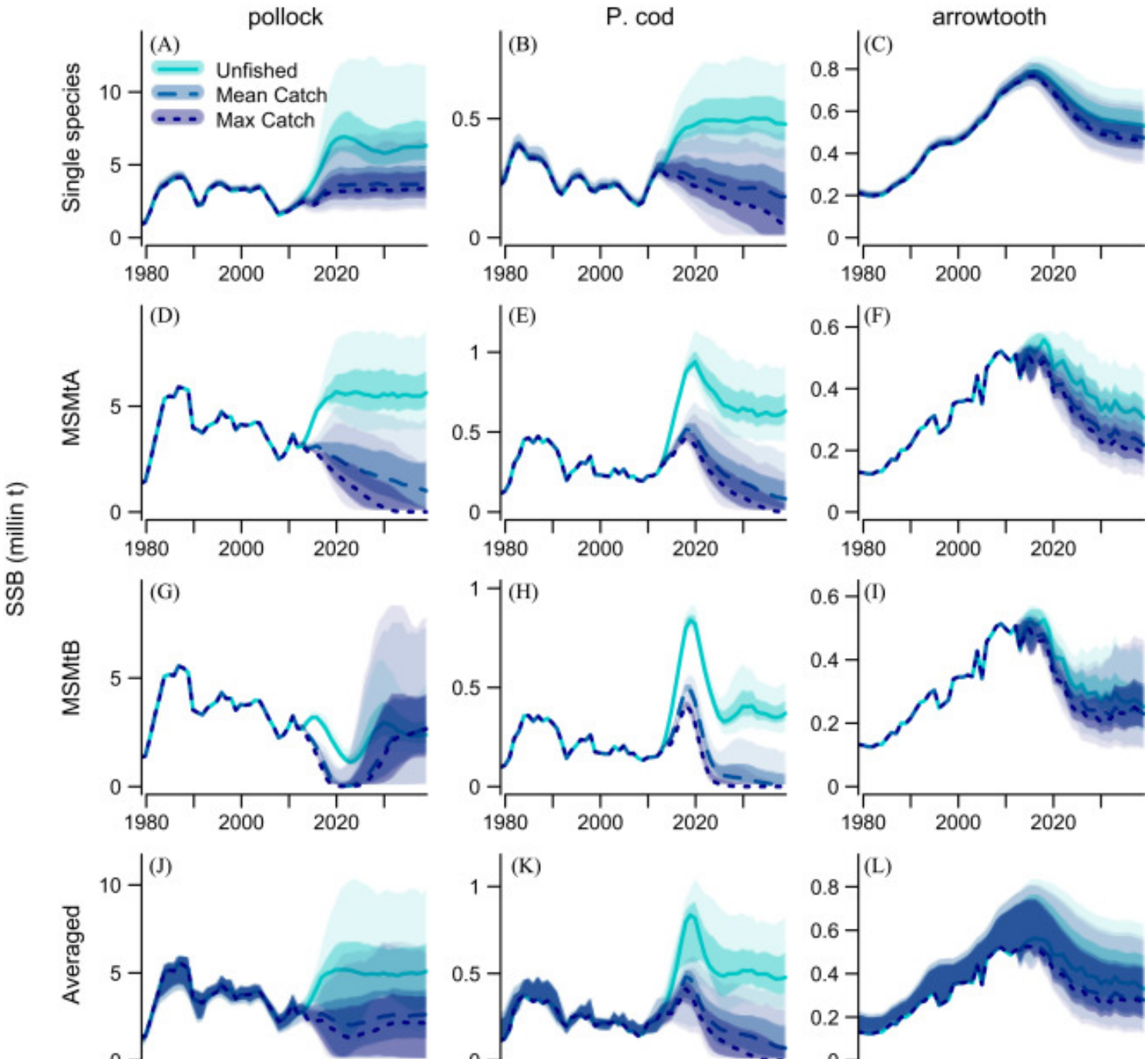
- Include effects of process error in projections (e.g. recruitment variability)
- Requires multiple realizations of stock dynamics
- Often achieved by Monte Carlo simulations.
- Summarize distribution of outcomes either by quantiles or risk metrics.


Monte Carlo paths
Asset prices
Time Steps
140
120
100
80
60
40
20
0
20
40
60
80
100
120
140
160

(Ichinokawa & Okamura 2014)



(Ianelli et al. 2016)



Lab exercise 1 - deterministic projection

- Using the Schaefer biomass dynamics model, conduct a deterministic 30 year projection, with fixed exploitation rates of F=0.1, F=0.2, and F=0.3.
- Summarize the results in terms of average catch over the projection, and final year biomass relative to BMSY. (hint, for the Schaefer model $BMSY = 0.5K$)