

Blacktip-Gulf Shark Assessment State-space, Age-structured Production Model

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Miami

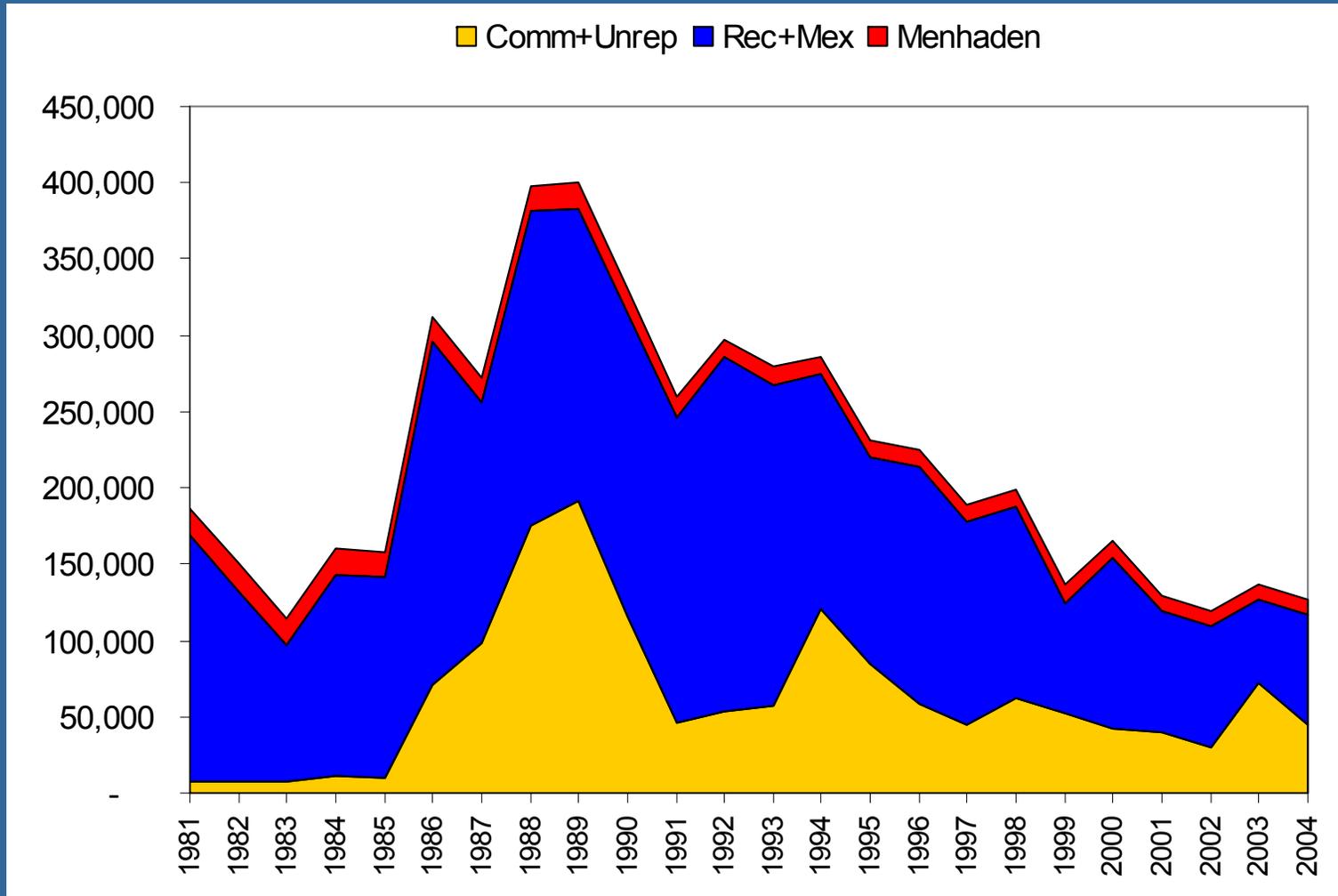
OUTLINE

1. Data Inputs
 - a. Fishery
 - b. Biology
2. Model Description
3. Base Model and Results
4. Sensitivity Cases
5. Summary of all Results
6. Continuity case

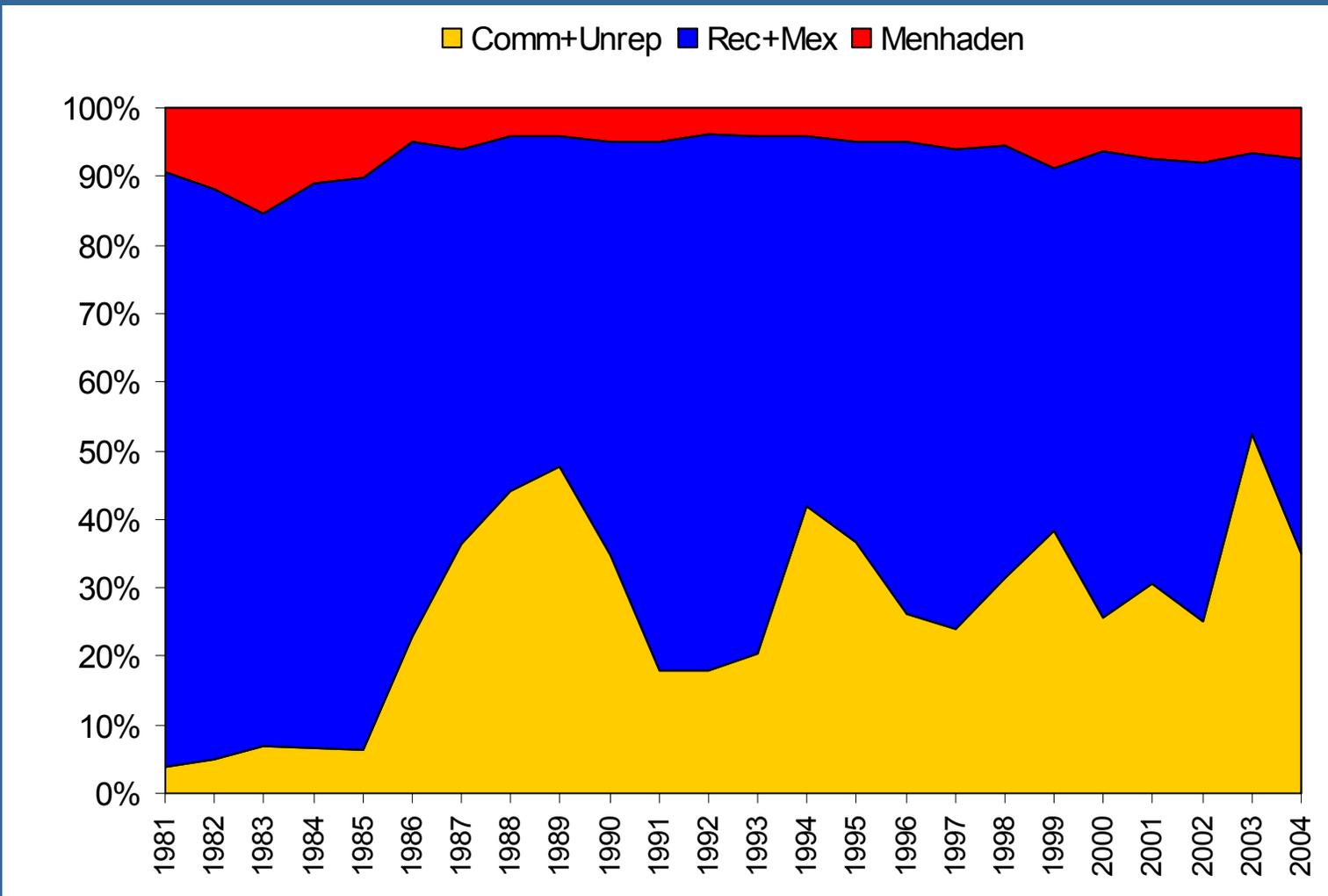
1a. Fishery Inputs

- Catch Series:
 - Commercial + Unreported Commercial
 - Recreational + Mexican + Unreported Mexican
 - Menhaden discard

Catches



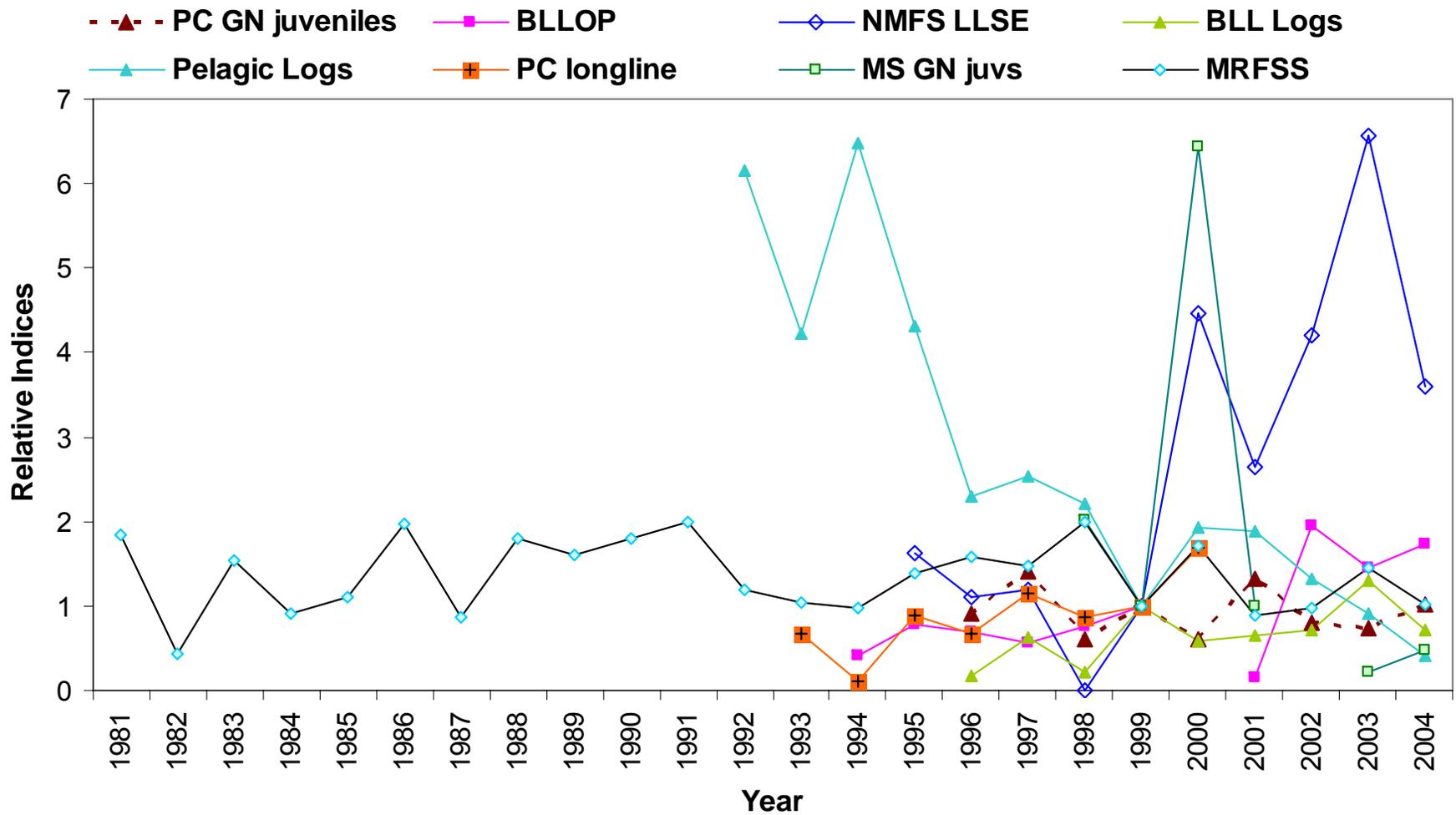
Catches



1a. Fishery Inputs

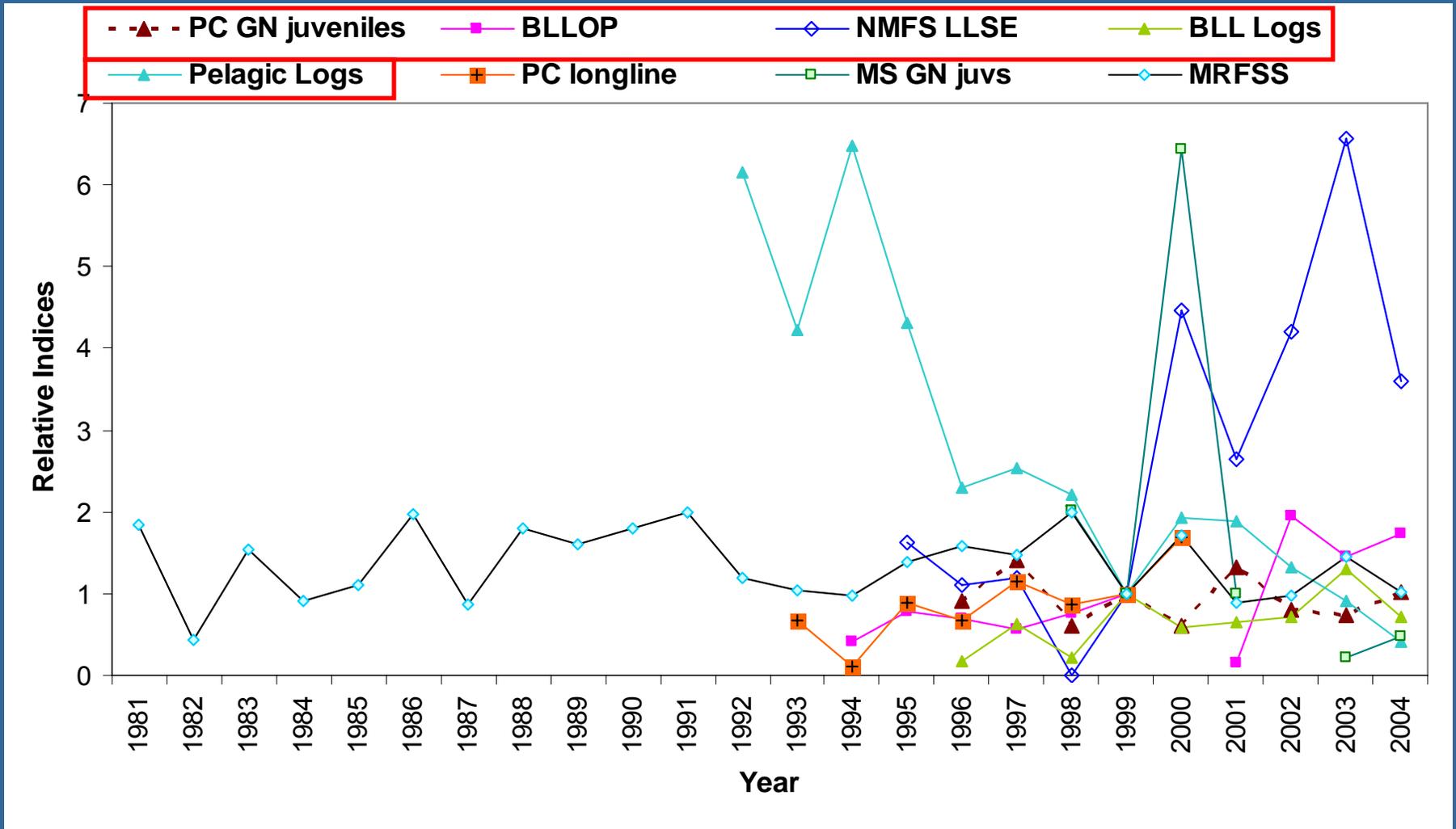
- Indices of Abundance:
 - BLLOP, NMFS LL SE, BLL Logs, Pelagic Log, PC LL
 - MRFSS
 - PC GN Juveniles, MS GN Juveniles

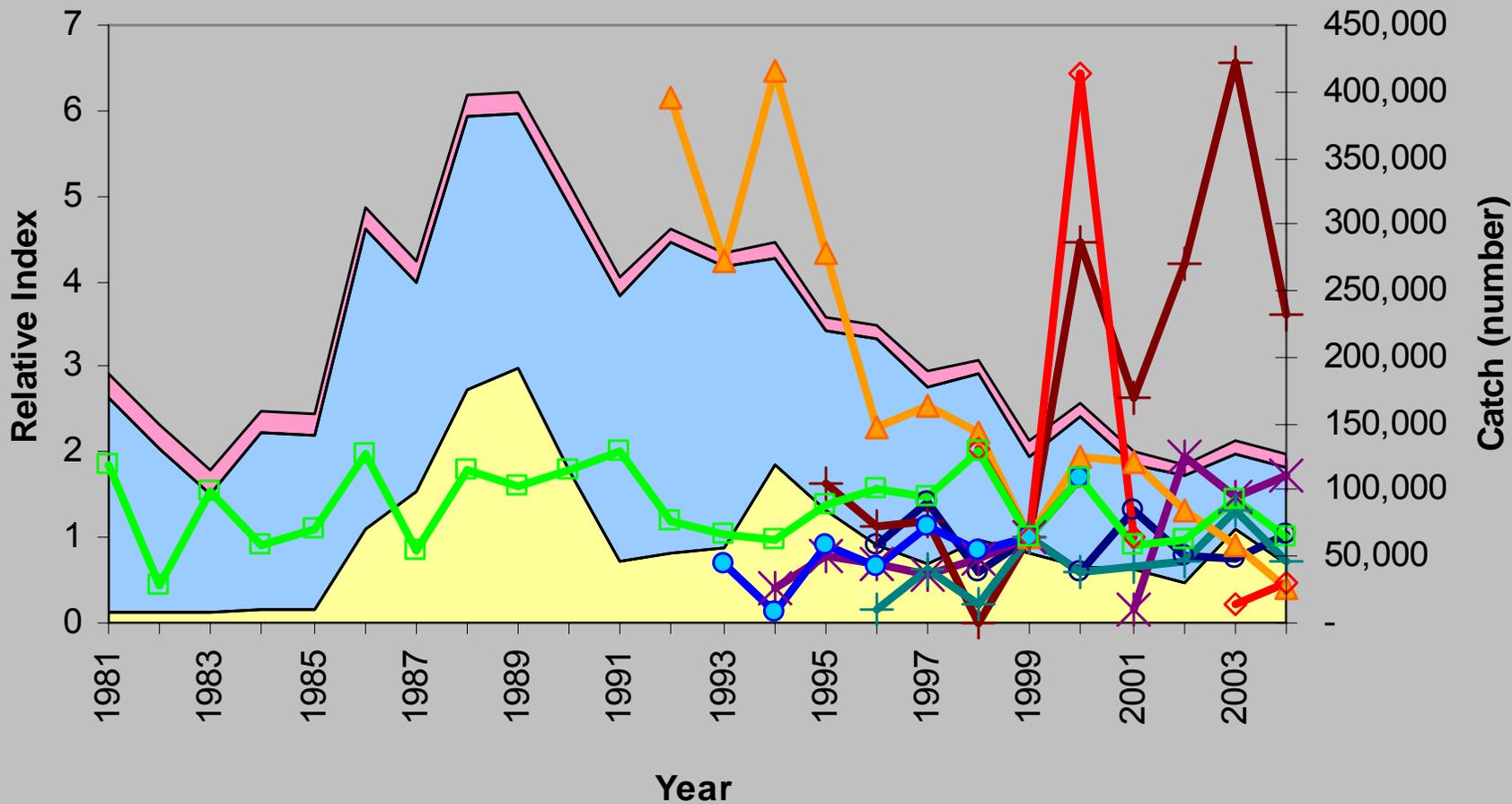
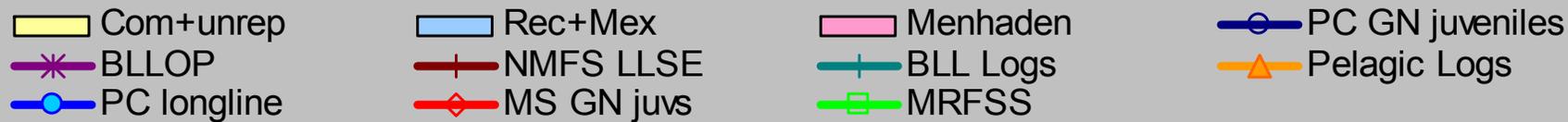
INDICES



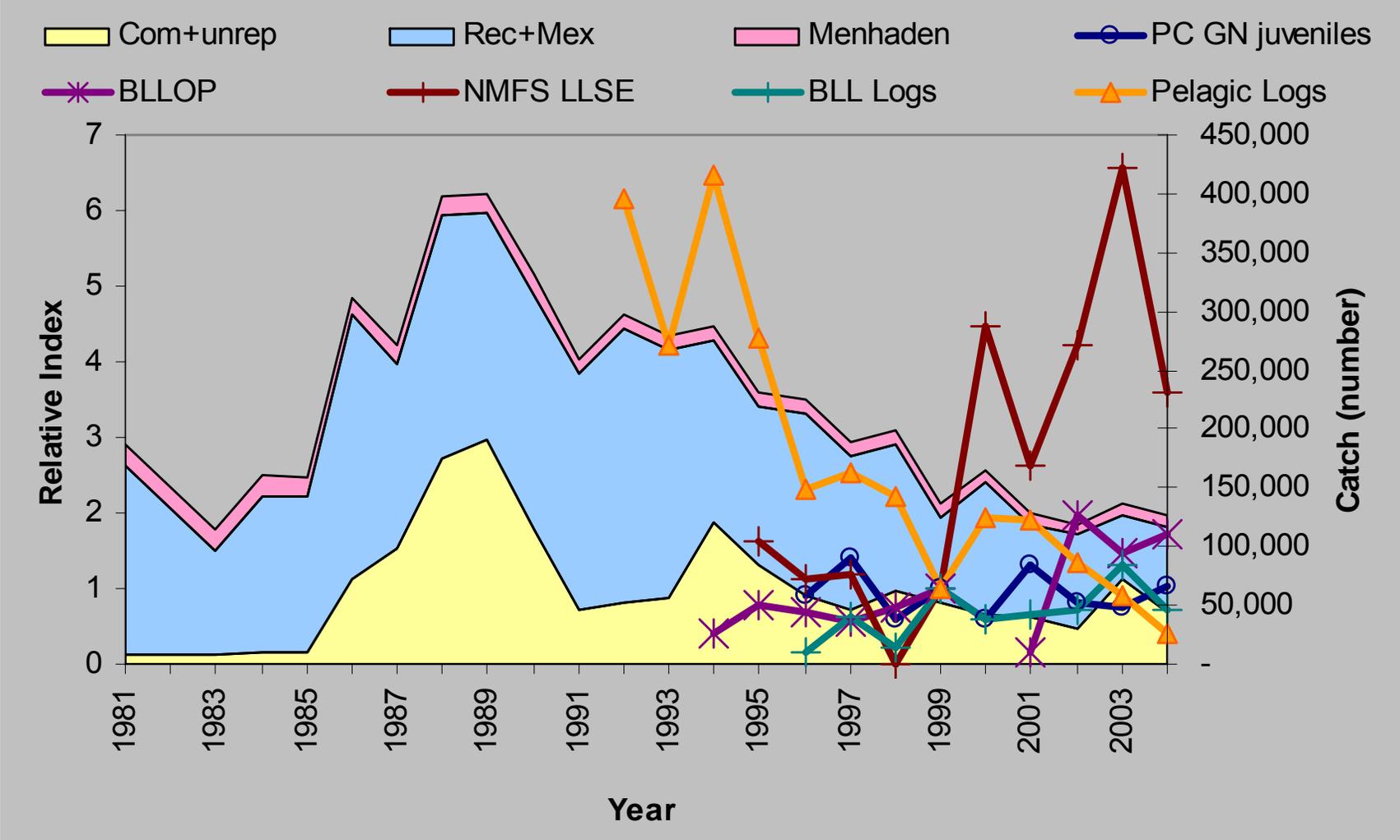
Base Indices

INDICES

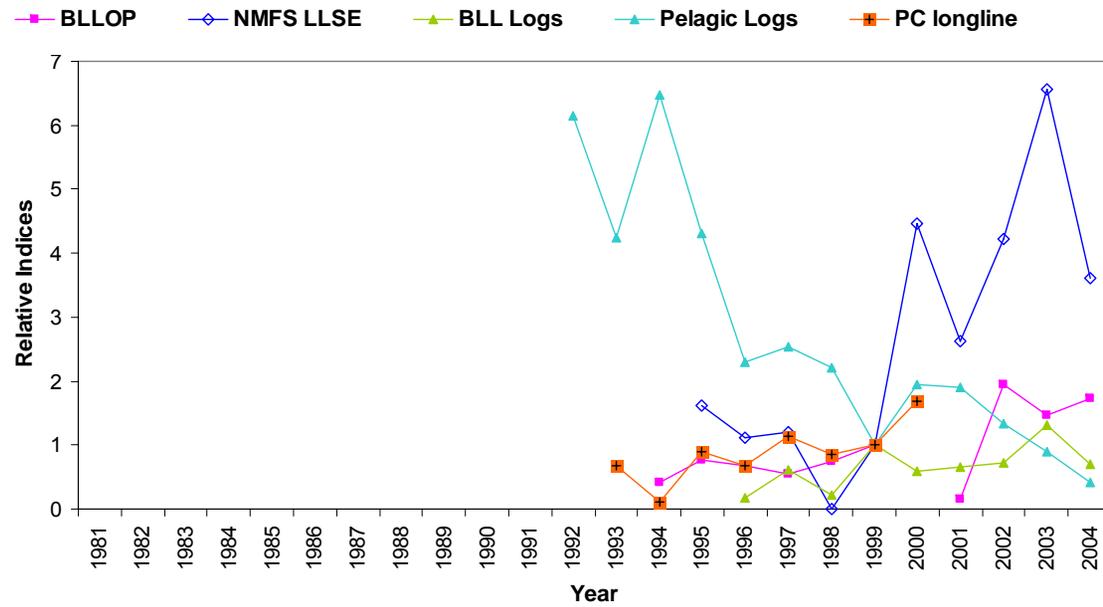




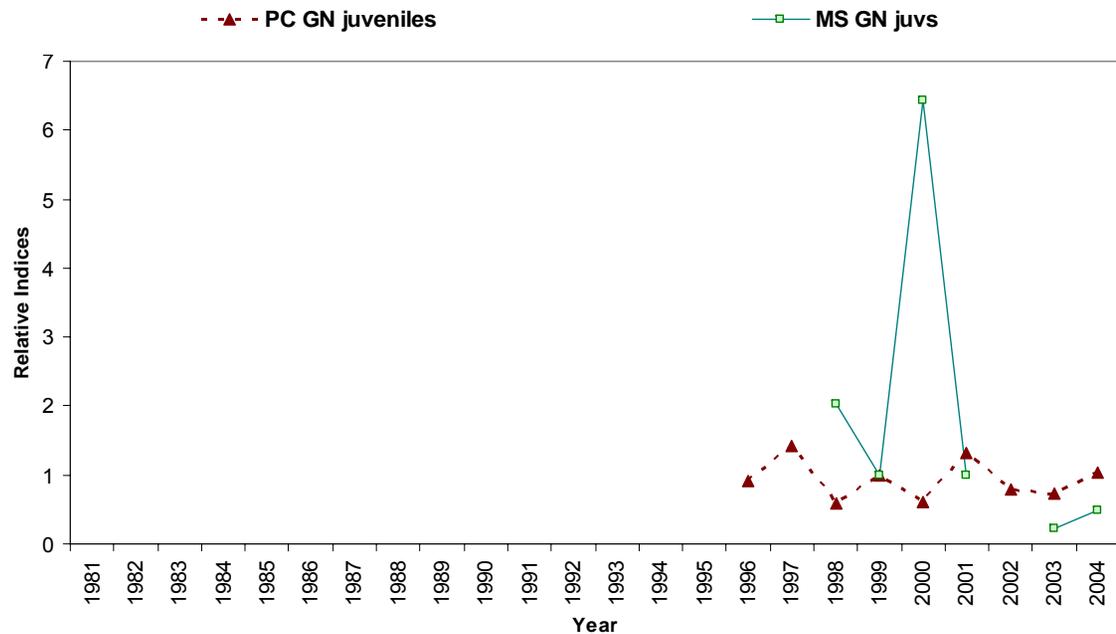
Base case inputs



Ages 7+
fully
selected



Ages 1-5
fully
selected



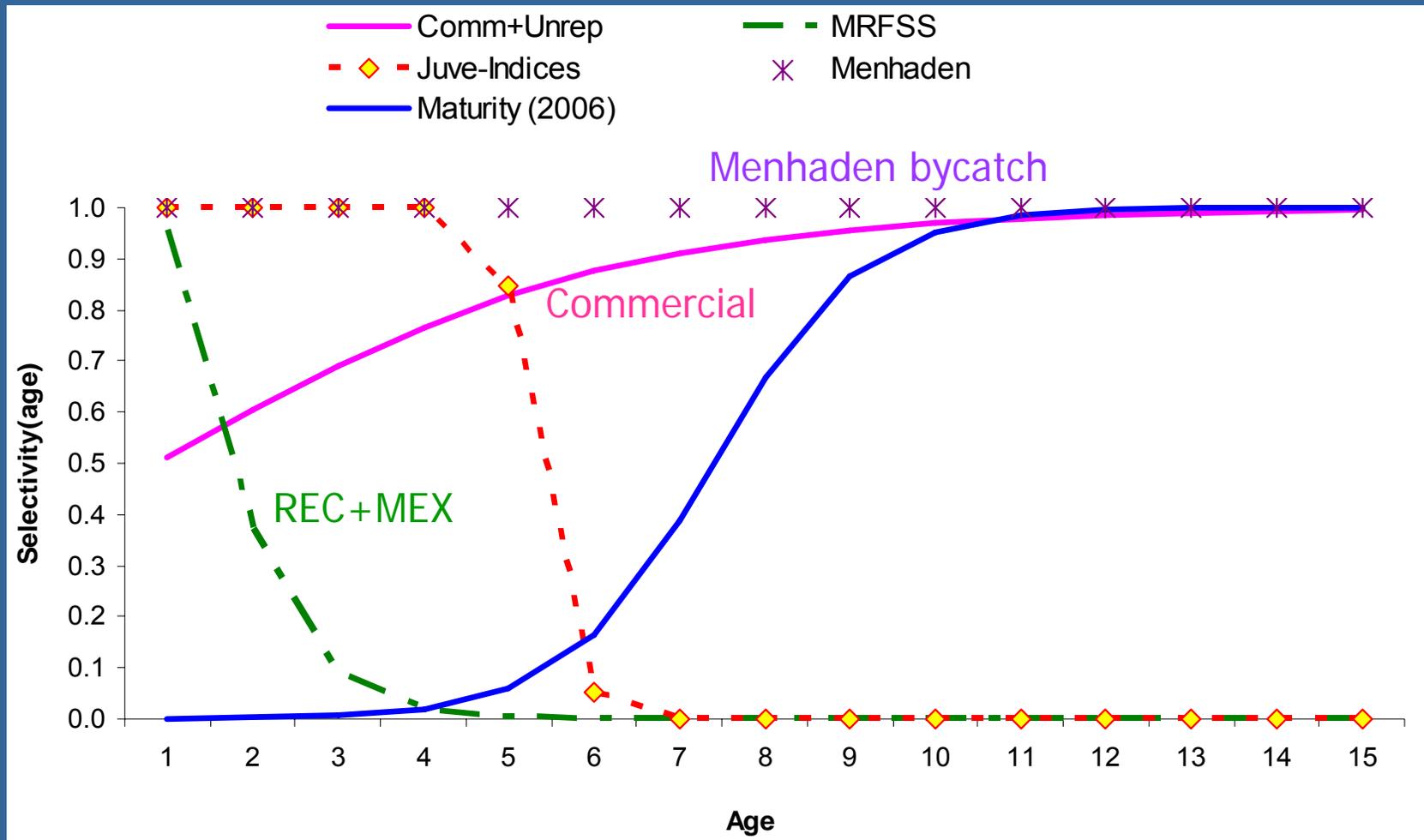
1a. Fishery Inputs

- Selectivity for catches:
 - Commercial + Unreported Commercial
 - Recreational + Mexican + Unreported Mexican
 - Menhaden discard

Selectivity Derivations

- Selectivity reflects both vulnerability to gear as well as availability to fishery
- P89 of AW report and pp38-39 of DW report
- some length frequency data, info from 2002 assessment, collective knowledge of fisheries and participants at DW

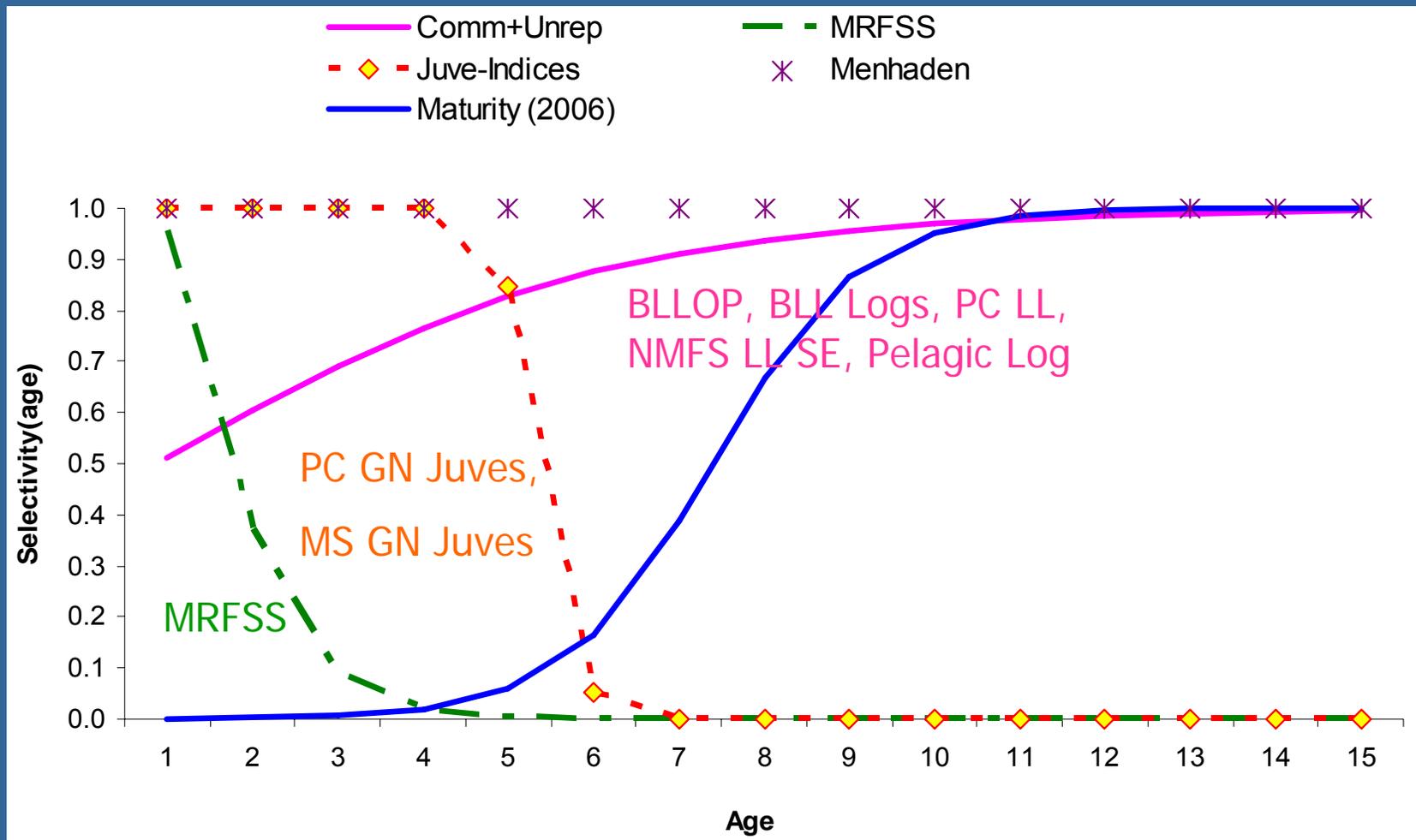
Selectivity - Catch



1a. Fishery Inputs

- Selectivity for Indices:
 - BLLOP, NMFS LL SE, BLL Logs, Pelagic Log, PC LL
 - MRFSS
 - PC GN Juveniles, MS GN Juveniles

Selectivity - Indices



1b. Biological Inputs – DW values

- Pup-production: 4.4
- Natural Mortality: 0.36 → 0.20
- Pup-Survival: mode 0.52
- Maturity: ~ 50% age 6.5;
~100% age 10
- Steepness: 0.2-0.5

Steepness – Max. Repro Rate (α)

- $\alpha = \text{pup.survival} \times \text{virgin.spawners.per.recruit}$

$$\alpha = \text{pup.survival} \times \varphi_0 = \sum_{age} fec_{age} \cdot mat_{age} \prod_{j=1}^{age-1} e^{-M_j}$$

- Steepness = $\alpha / (\alpha + 4)$

1b. Biological Inputs – DW values

- Pup-production: 4.4
- Natural Mortality: 0.36 → 0.20
- Pup-Survival: mode 0.52
- Maturity: ~ 50% age 6.5;
~100% age 10

~~■ Steepness: 0.2-0.5~~

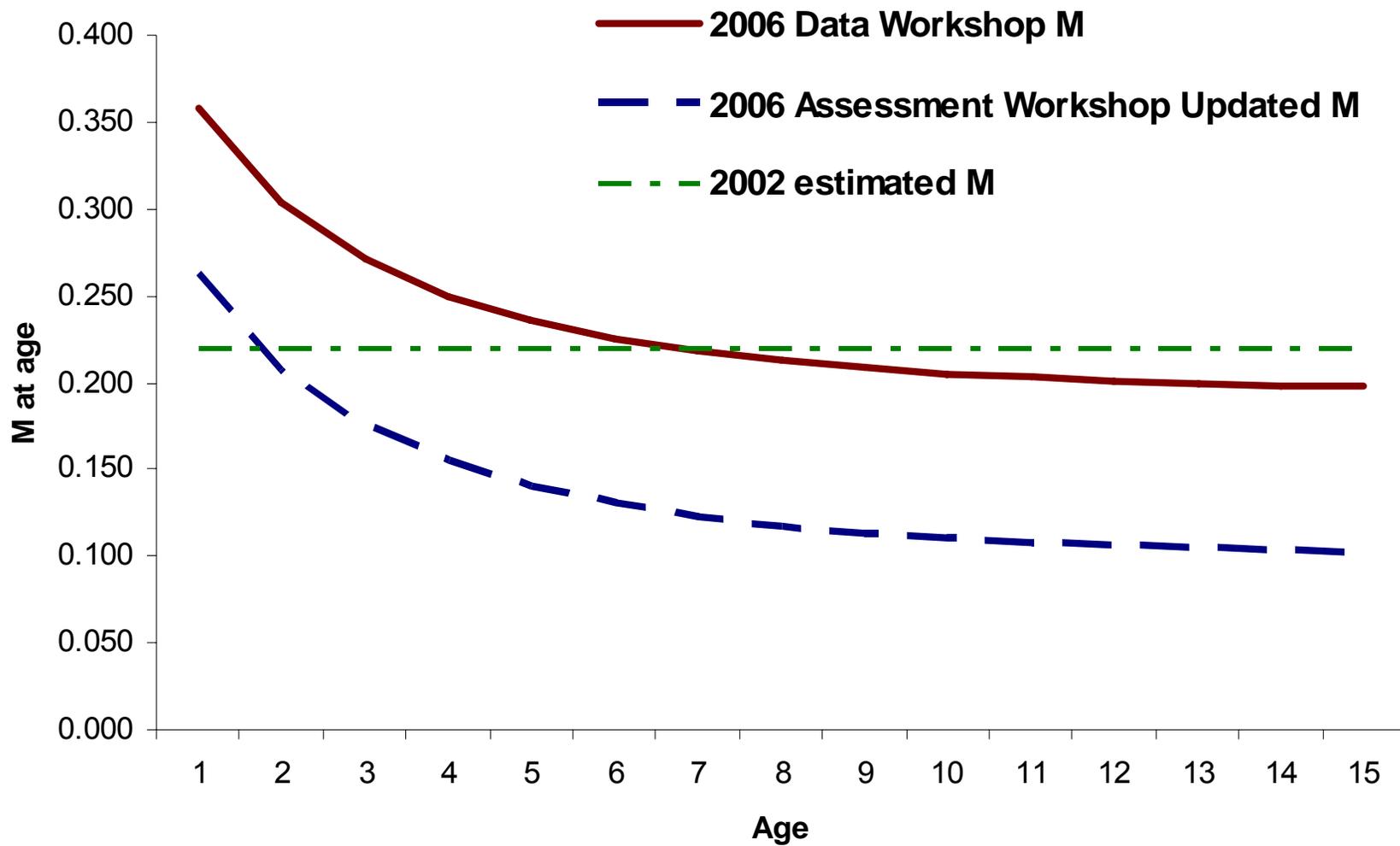
0.12

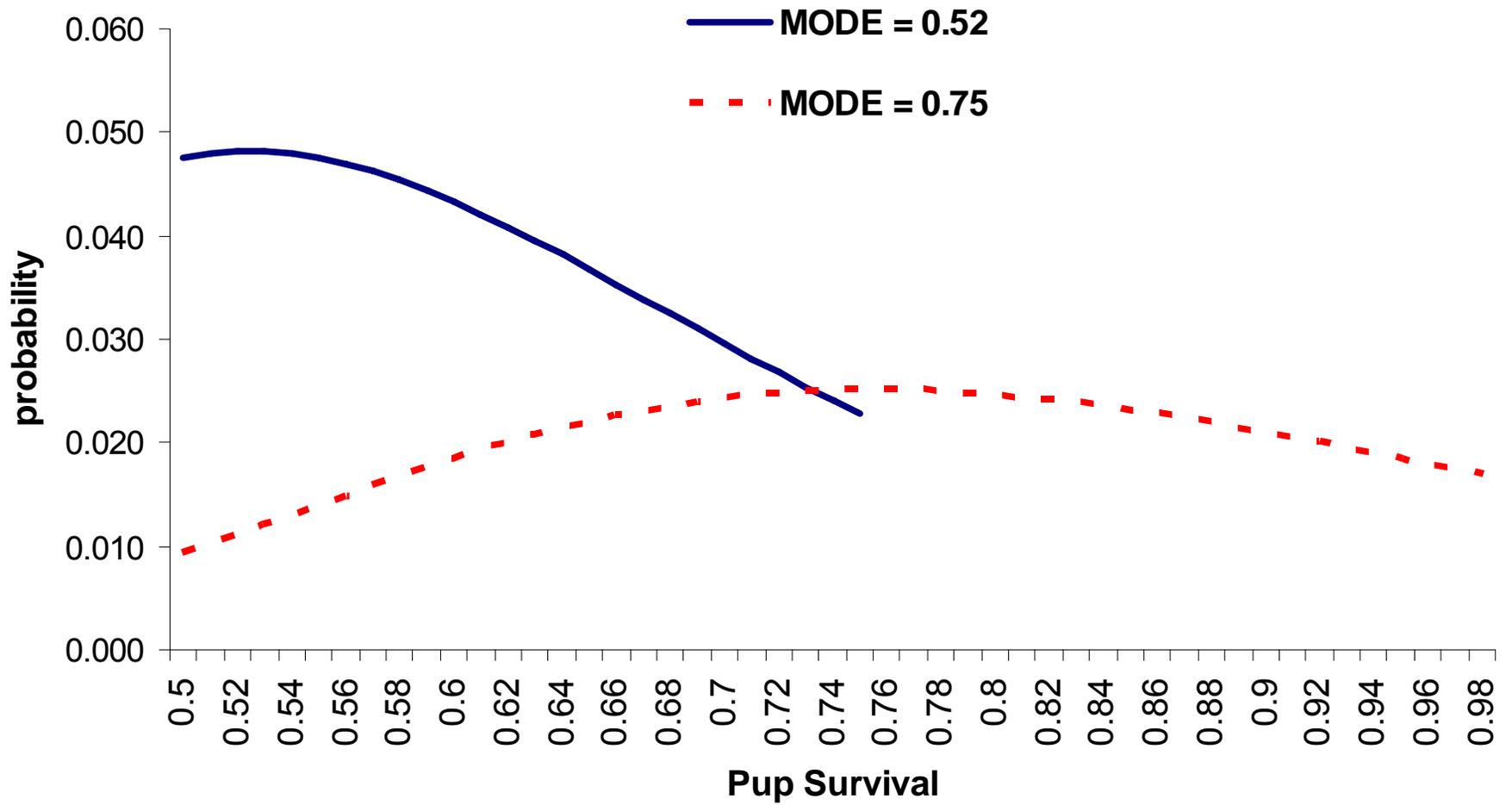
steepness only defined on [0.2 , 1.0]

1b. Biological Inputs – AW updates

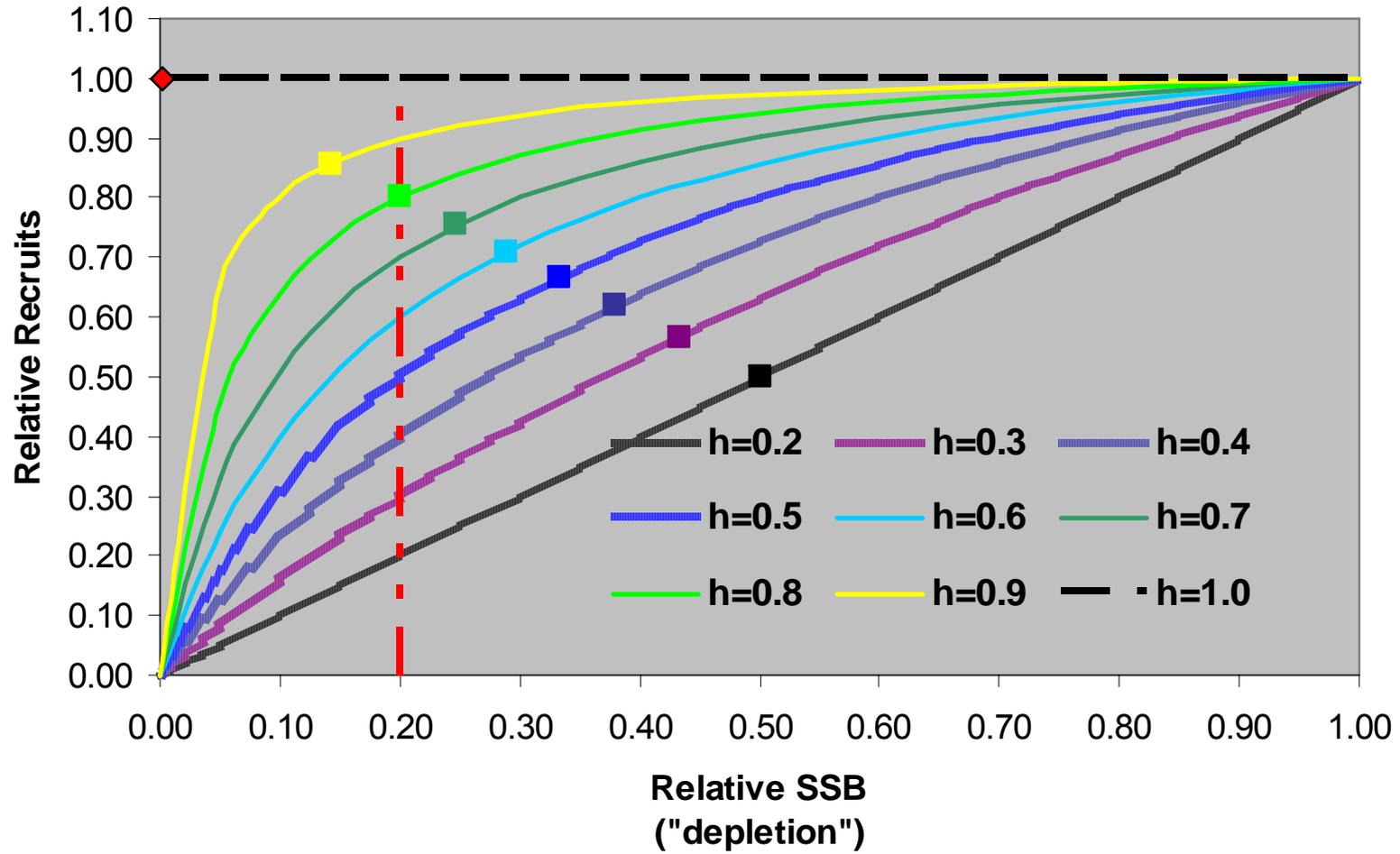
- Pup-production: 4.4
- Natural Mortality: 0.36 → 0.20 0.26 → 0.10
- Pup-Survival: mode 0.52 0.75
- Maturity: ~ 50% age 6.5;
~100% age 10
- Steepness: 0.2-0.5 0.4

**NOTE: Same problem with steepness in 2002,
but pup-production was increased**

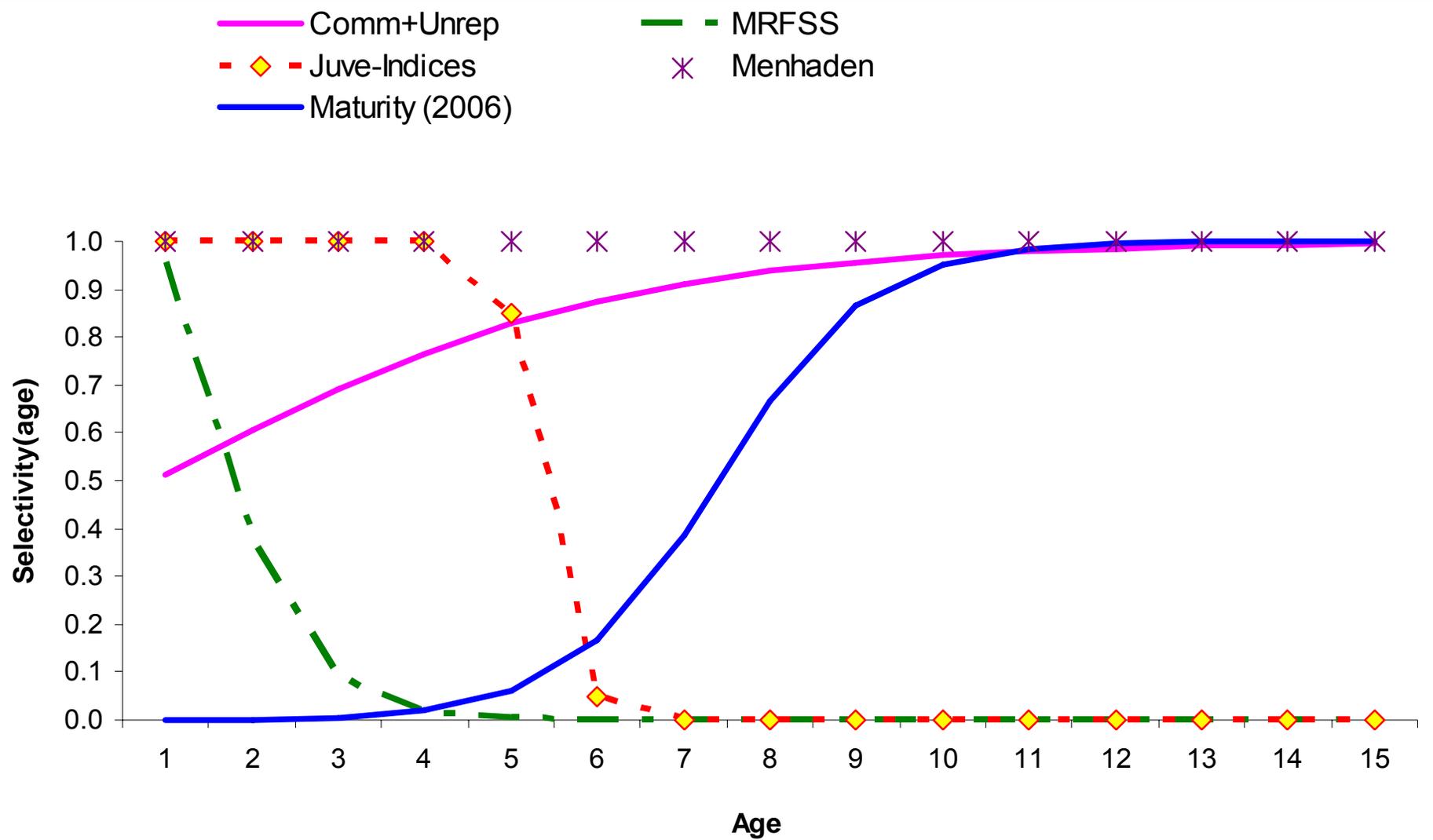


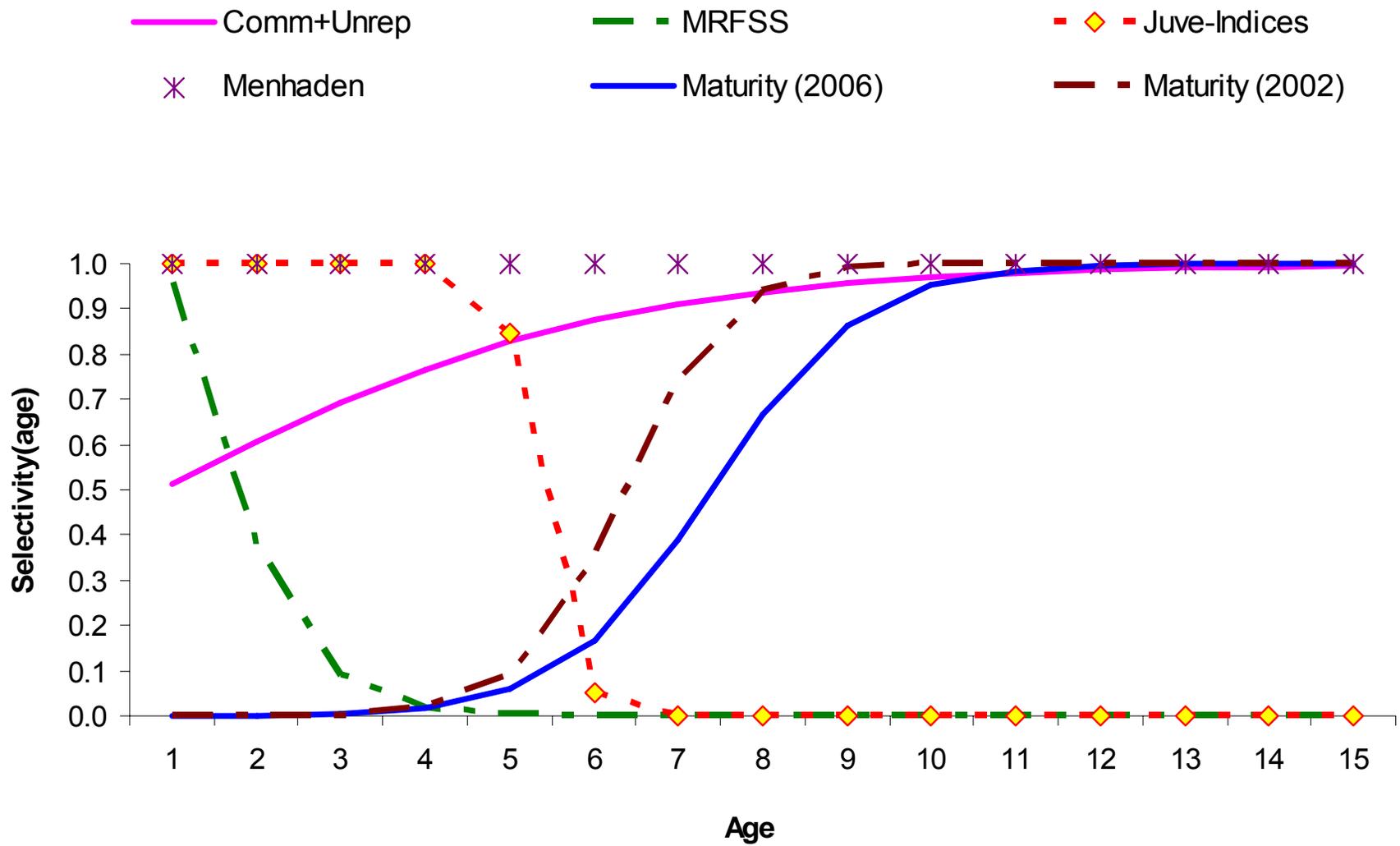


Beverton-Holt



Steepness of 0.2-0.4 → factor of about 4 between survival at origin vs virgin





2. Model Description*

- State-space Age-structured Production model
- Process error in reproduction (pup-survival and virgin number pups), fishing effort
- Observation error in catches and indices
- Recruitment at age 1; ages 1-15 modeled, age 15 is a plus group

*See pp135-138 for model equations

2. Model Description

- Initial population structure at equilibrium
- Option to estimate historic fishing level F_H
- Fixing $F_H=0$ forces virgin conditions at start of model

2. Model Description

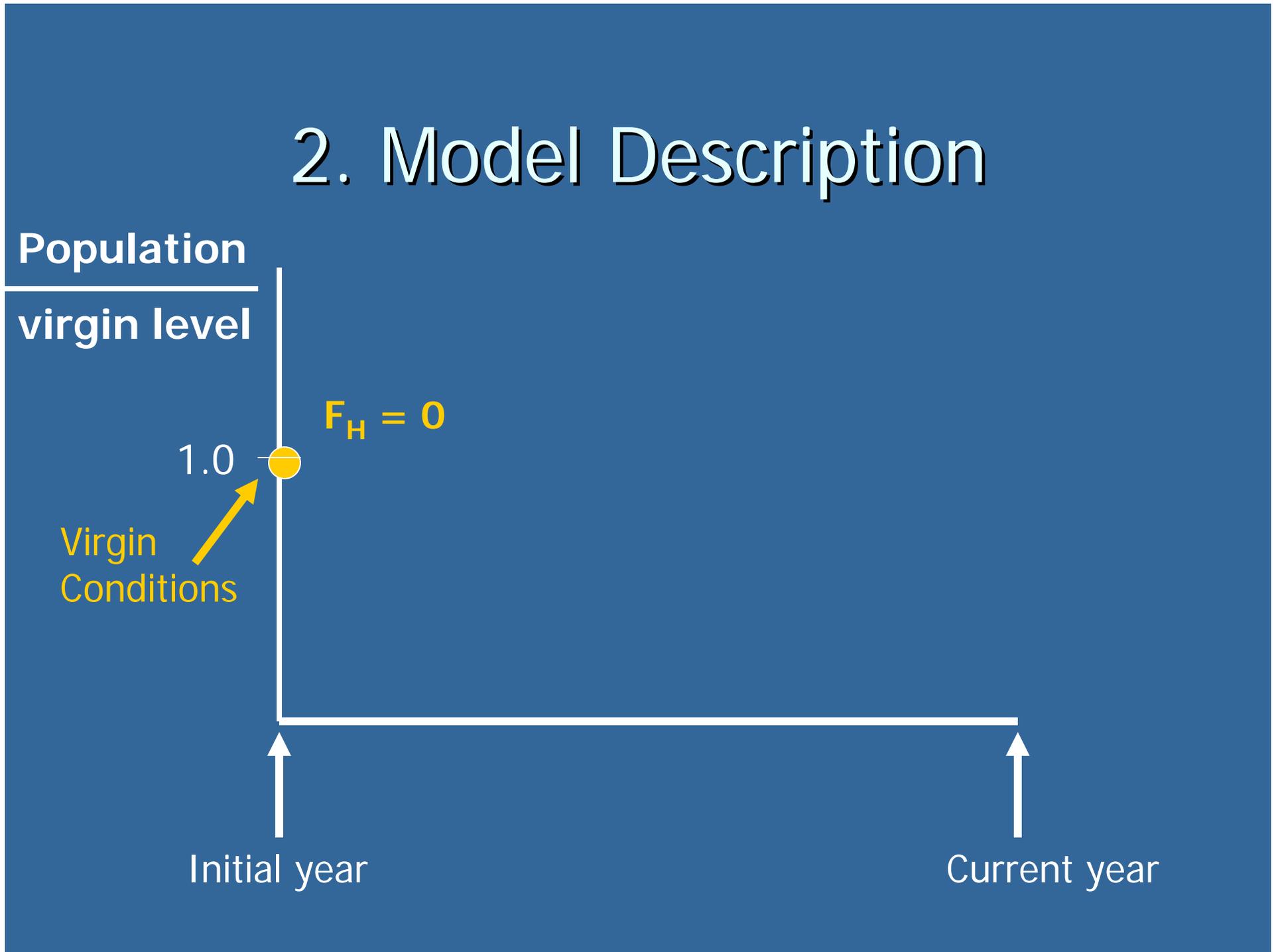
Population
virgin level

1.0
Virgin
Conditions

$$F_H = 0$$

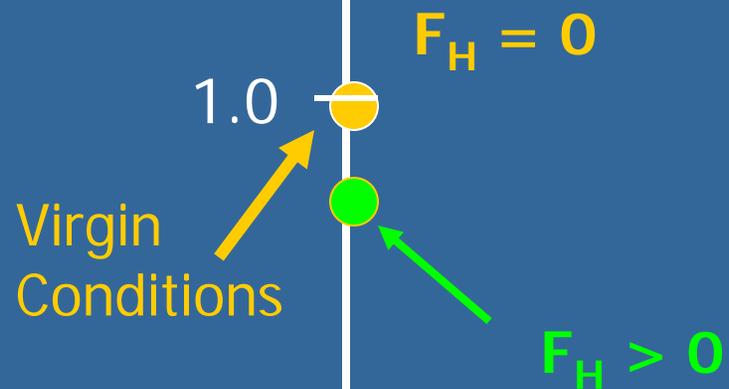
Initial year

Current year



2. Model Description

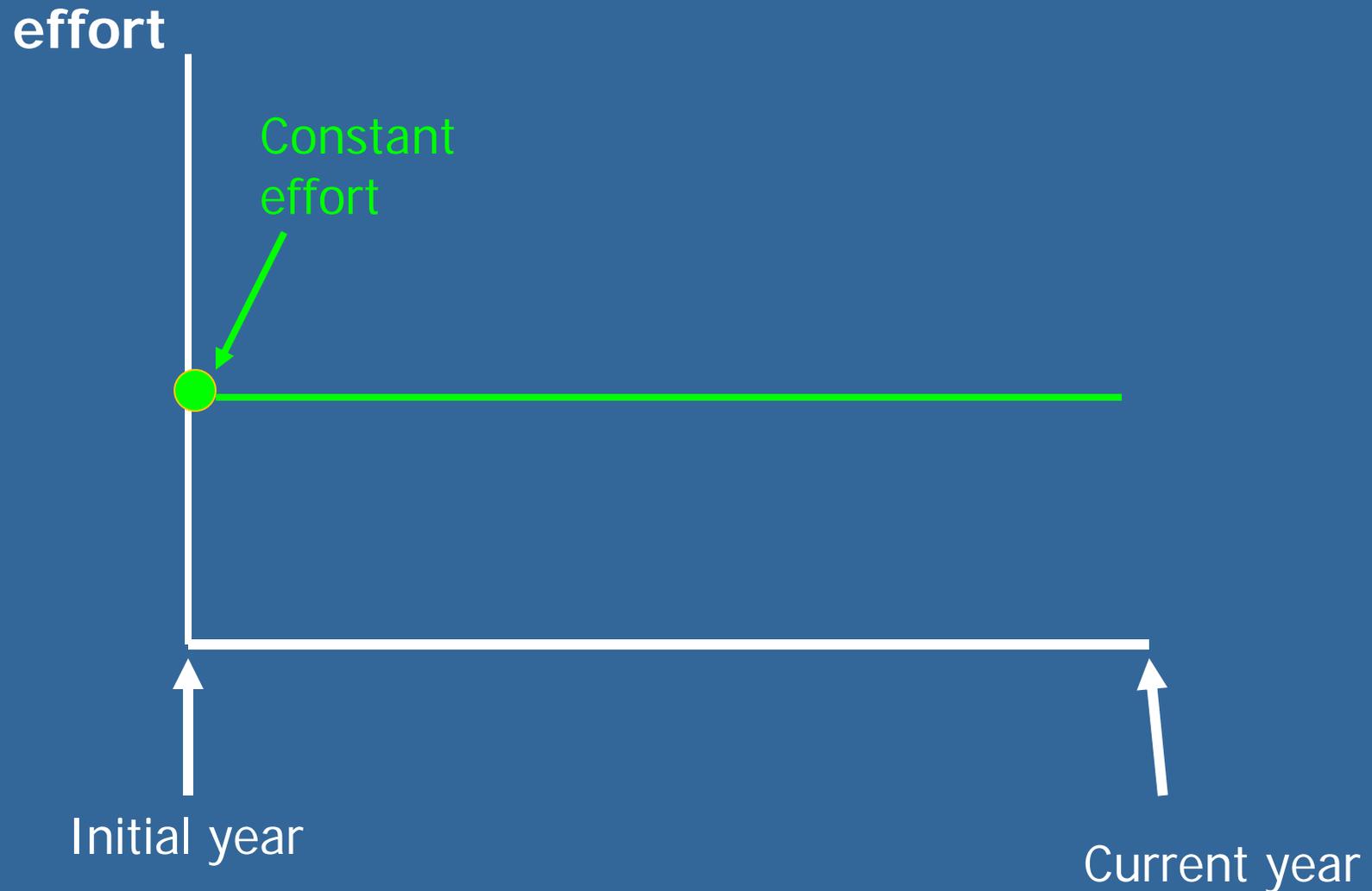
Population
virgin level



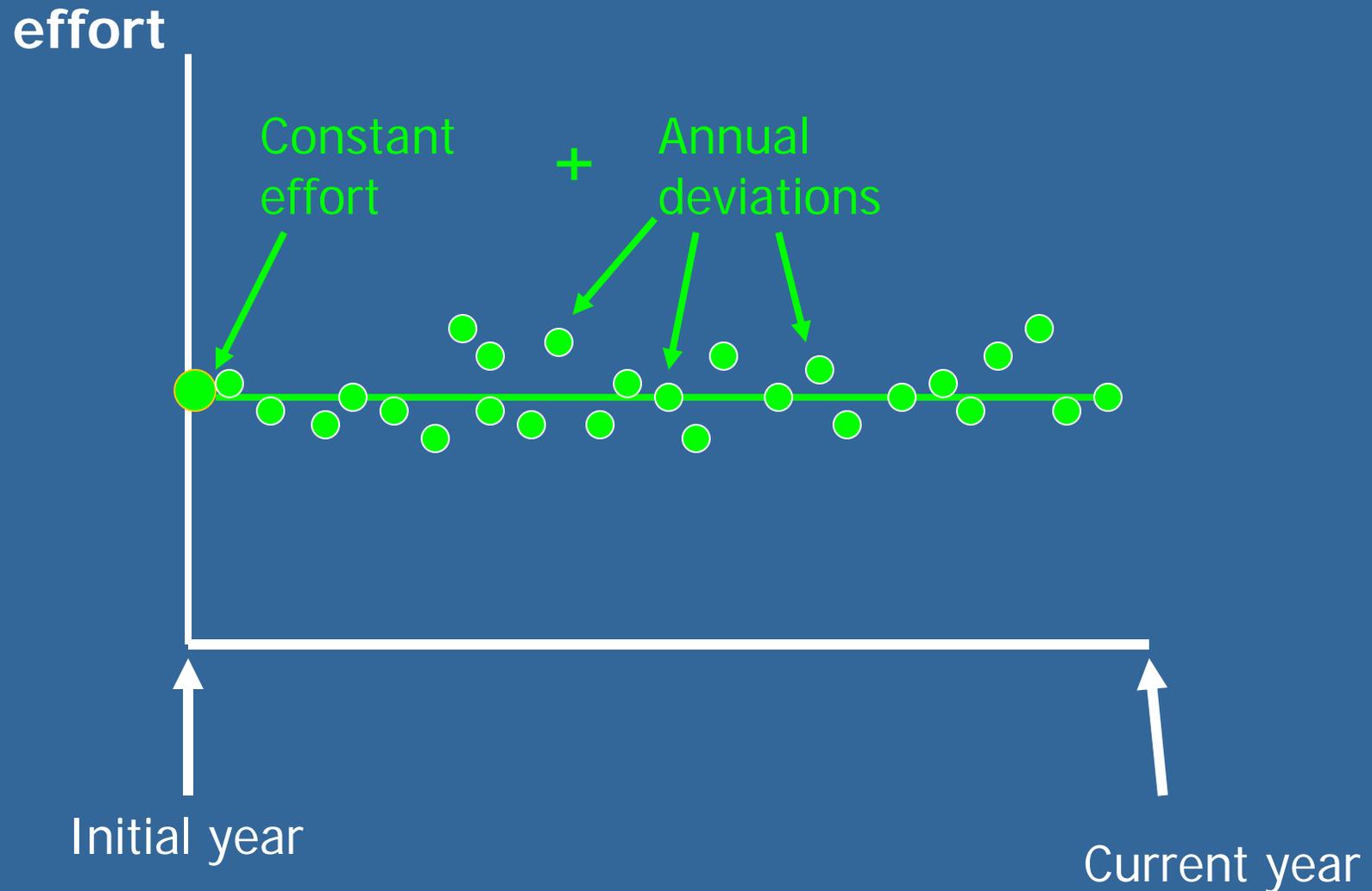
Initial year

Current year

2. Model Description



2. Model Description



2. Model Set-up

- Estimated catch series begin in 1981
- Earliest index (MRFSS^{*}) begins in 1981; earliest base index begins in 1992

*MRFSS is a sensitivity index

3. Base Model and Results

- Virgin conditions: 1981 ($F_H = 0$)
- Updated biological parameters
- Base case indices (updated Pelagic LL)
- Catches “fit” 5 times “better” than indices

3. Base Model and Results

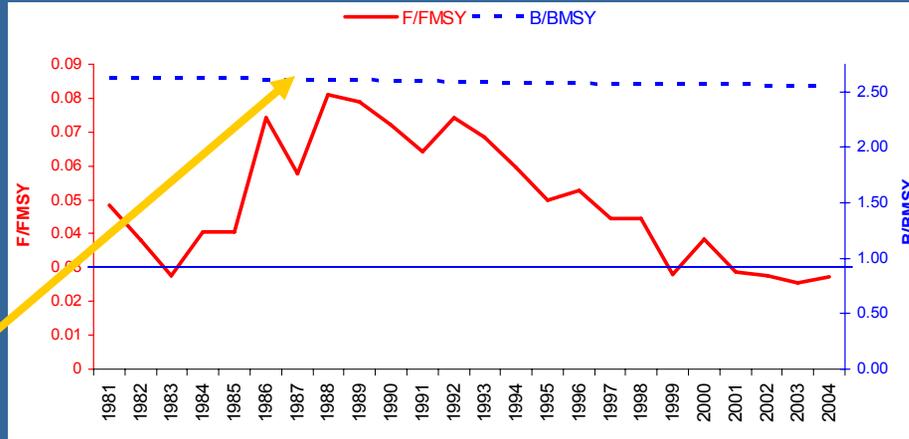
- $SSF_{2004}/SSF_{MSY} = 2.56 \rightarrow$ **NOT** overfished
- $F_{2004}/F_{MSY} = 0.03 \rightarrow$ **NO** overfishing
- Steepness = 0.40
- $SPR_{MSY} = 0.62$
- $F_{MSY} = 0.20$

Fig 5.5

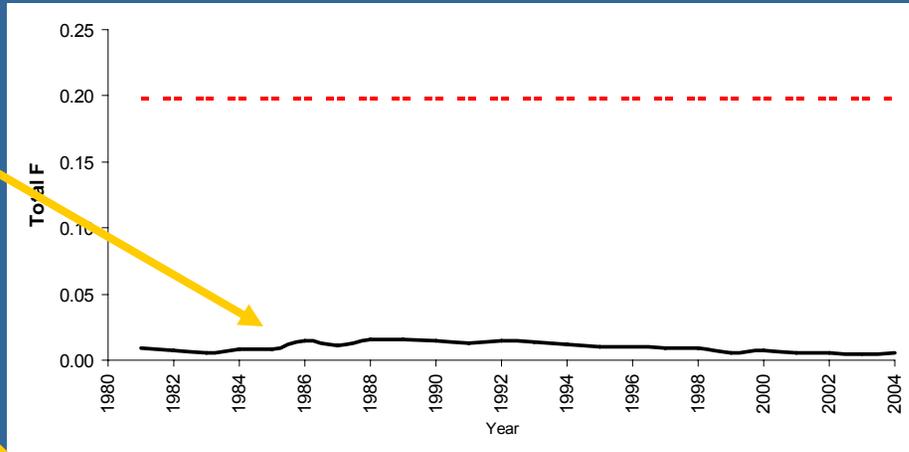
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No impact from catches

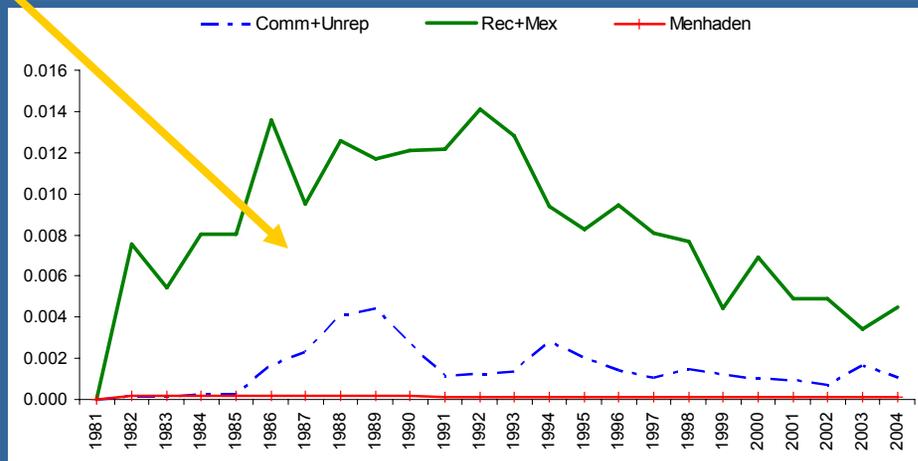
Very small F values



F/F_{MSY} and B/B_{MSY}



Total F and F_{MSY}

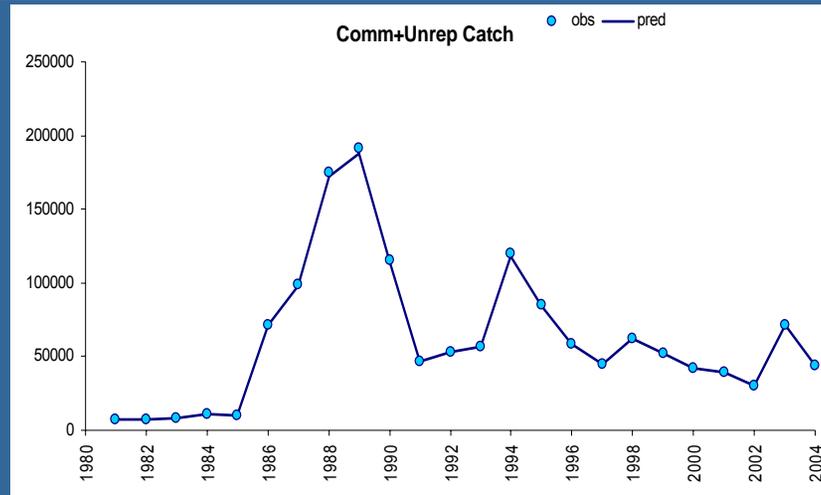


F by fleet

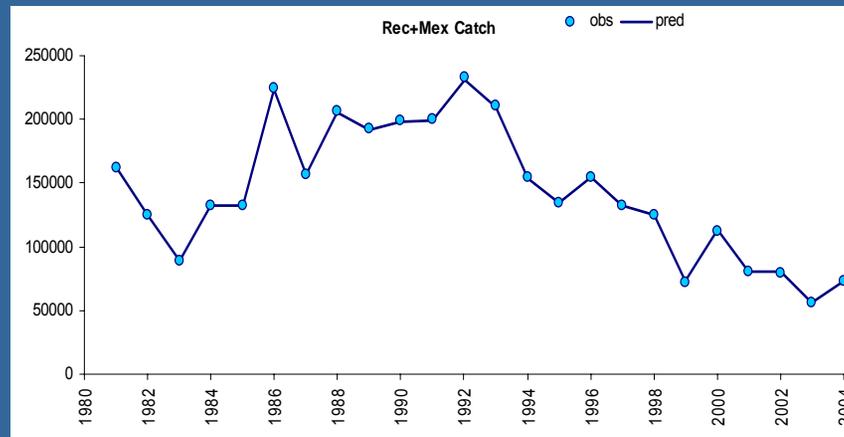
CATCHES

Fig 5.7

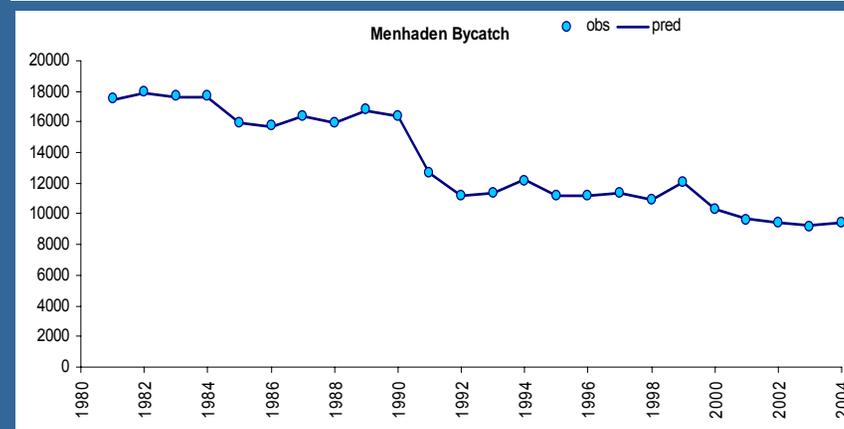
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Commercial +
Unreported



Recreational
+ Mexican



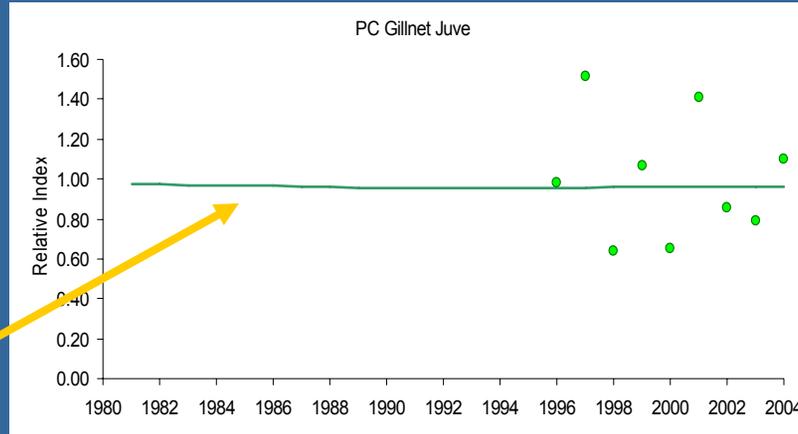
Menhaden
discard

INDICES

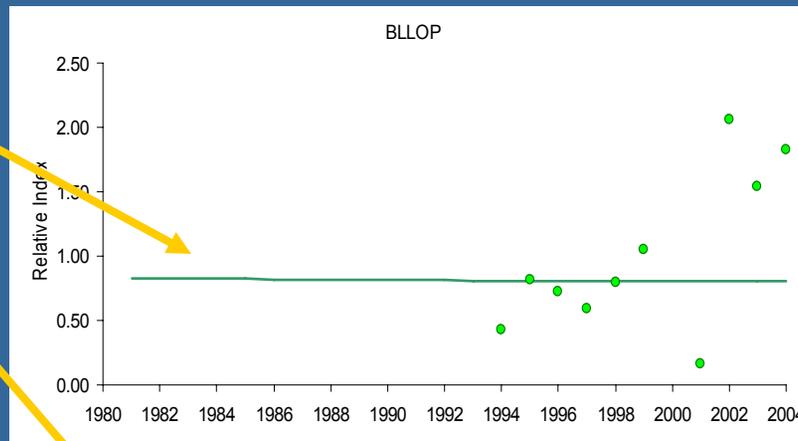
Fig 5.8

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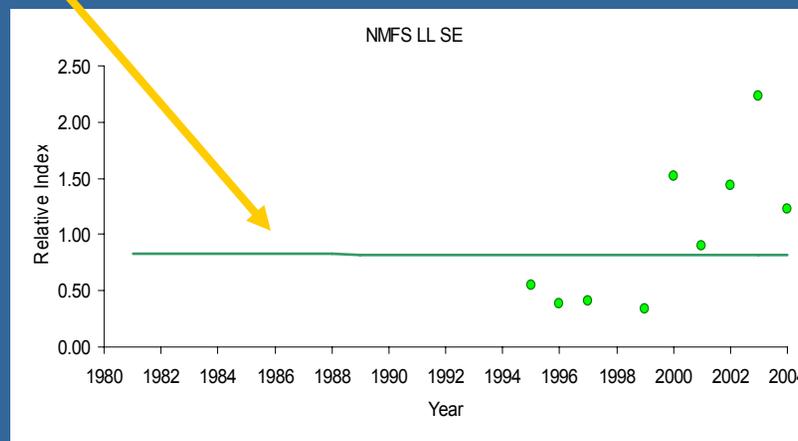
No impact
from catches



PC GN Juves



BLLOP



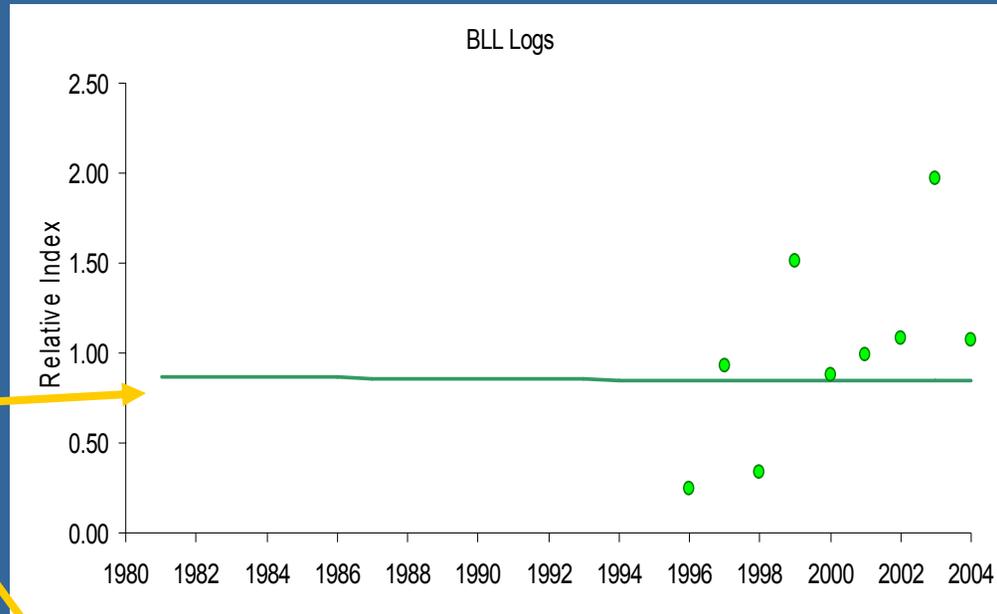
NMFS-LL-SE

INDICES

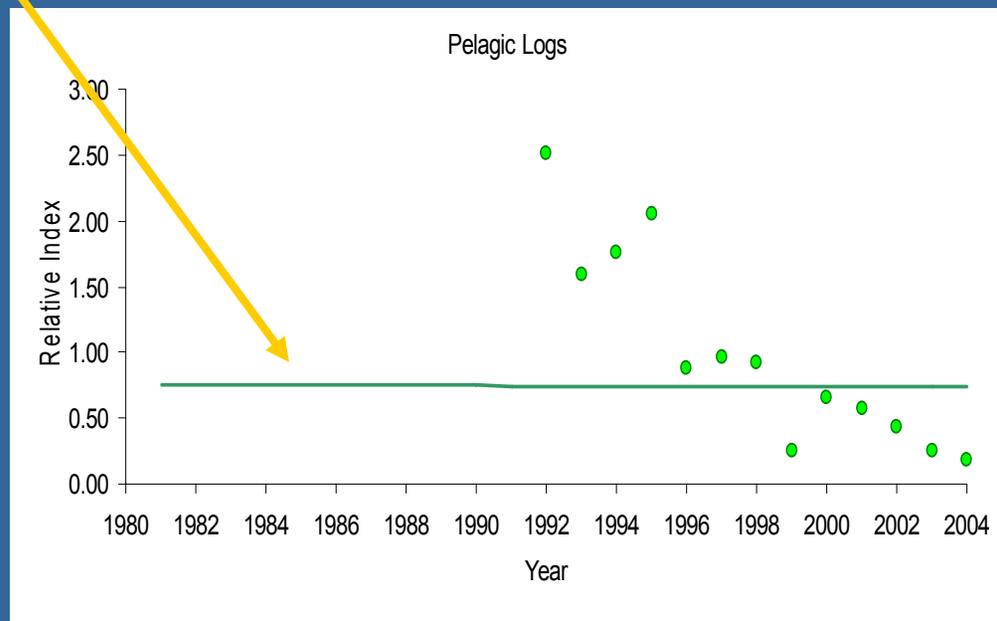
Fig 5.8

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No impact
from catches



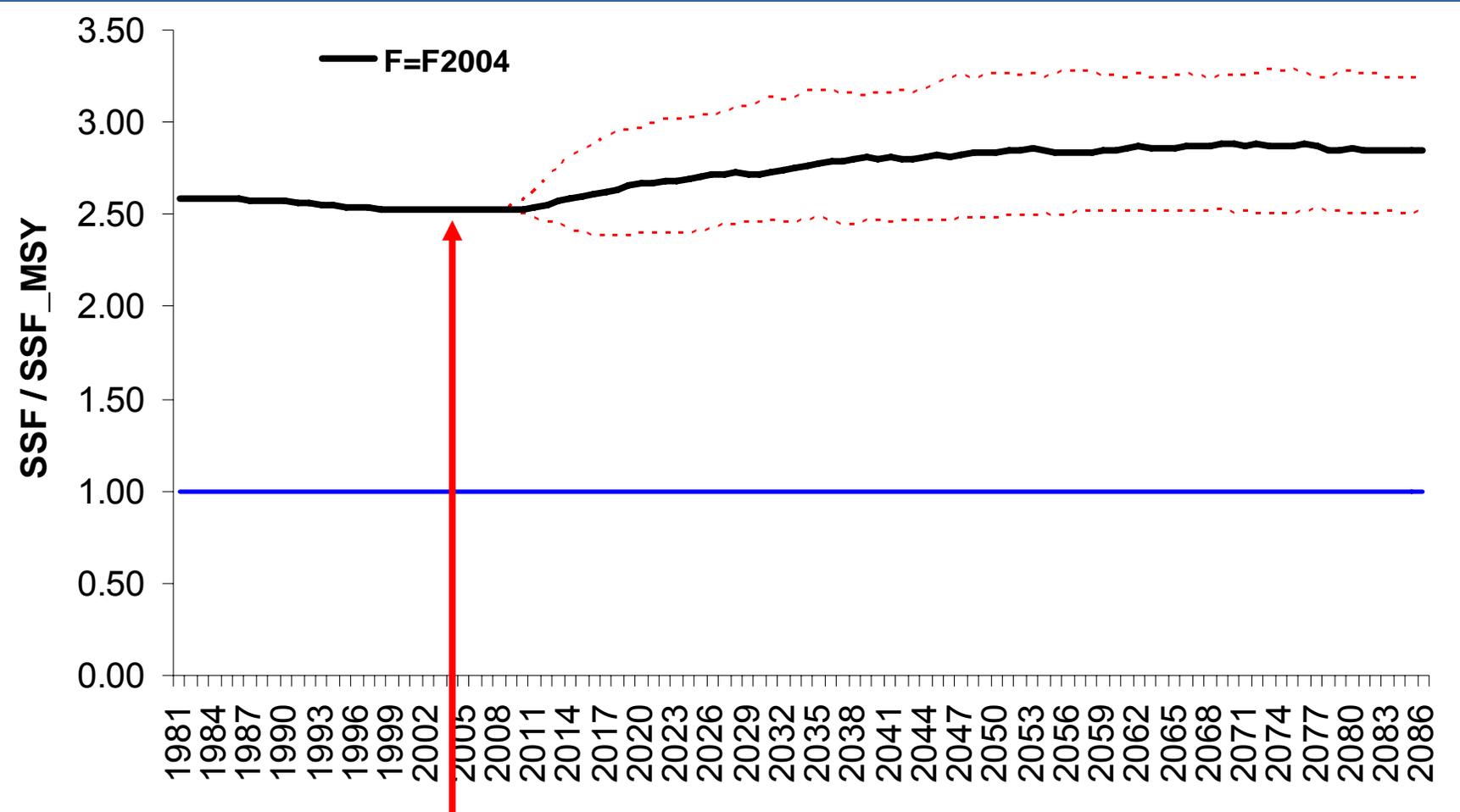
BLL Logs



Pelagic Logs

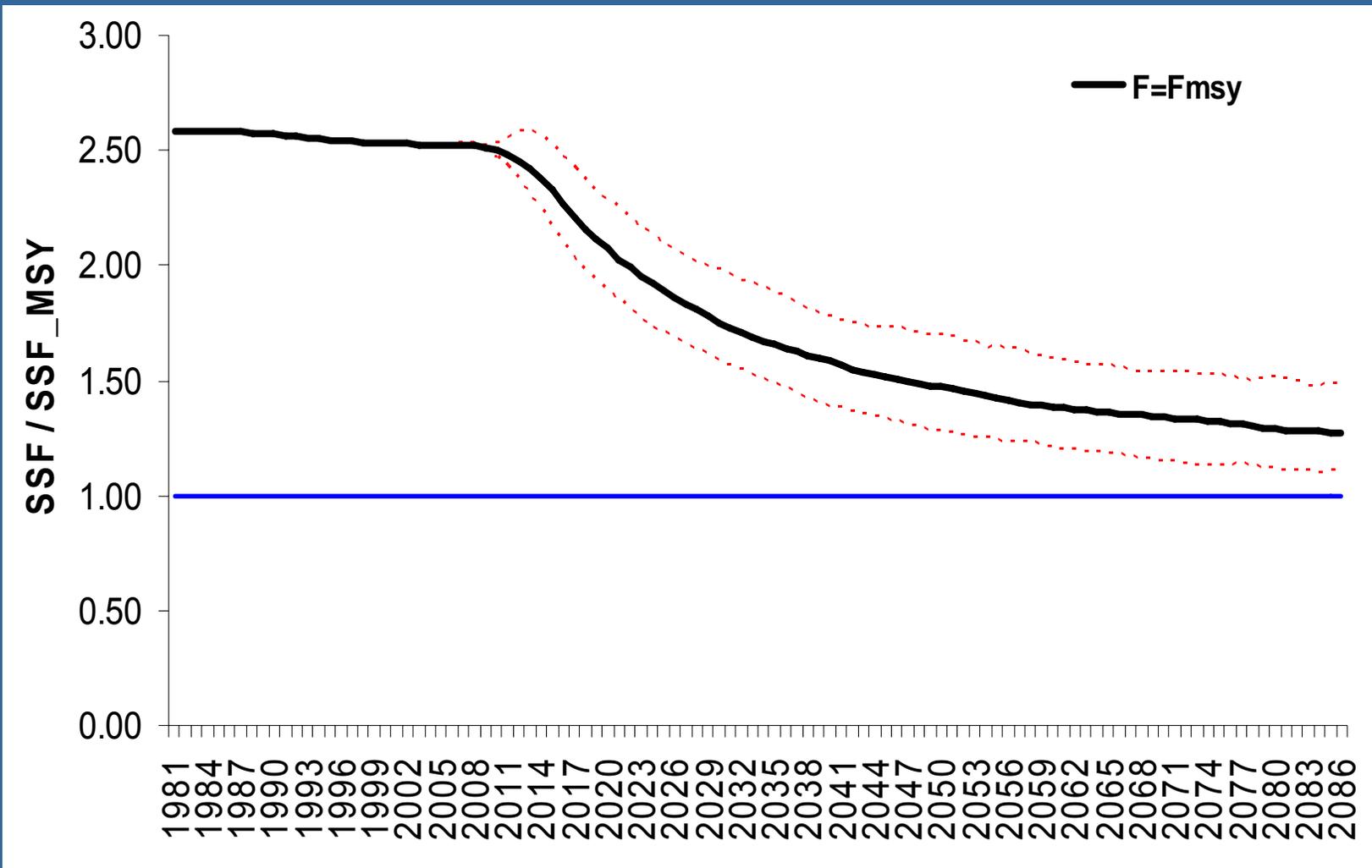
3. Base Model and Results

- Projection Scenarios
 - Constant $F = F_{2004}$
 - Constant $F = F_{MSY}$



2004

NOT overfished, so no rebuilding target



MSY $2.42E+7$ kg

$C_{2004} \sim 126,312$ sharks

Model Est. $Y_{2004} \sim 1.34E+6$ kg

4. Sensitivity Analyses

- BTG-1: no Pelagic LL index
- BTG-2: all indices used
- BTG-3: inverse CV weighting

5. Summary of all Results

Parameter	Base		BTG-2		BTG-3	
	Est	CV	Est	CV	Est	CV
AICc	282.495		47.6284		421.414	
Obj. Fn	-1.59E+02		-1.80E+02		-8.91E+01	
MSY (kg)	2.42E+07	--	2.28E+07	--	1.56E+07	--
Pups-virgin	1.44E+07	1.79	1.36E+07	1.01	9.99E+06	3.68
SSF2004	4.55E+07	1.83	4.29E+07	1.03	3.12E+07	3.80
Nmature2004	1.98E+07	1.83	1.86E+07	1.03	1.36E+07	3.80
B2004	1.93E+09	1.83	1.82E+09	1.03	1.33E+08	3.80
B2004/B-virgin	0.87	0.04	0.87	0.02	0.86	0.12
SSF2004/SSF-virgin	0.93	0.04	0.92	0.03	0.92	0.13
Nmature2004/Nmature-virgin	0.89	0.04	0.88	0.03	0.88	0.13
SSF2004/SSFMSY	2.56	0.29	2.54	0.29	2.54	0.33
SPRMSY	0.62	--	0.62	--	0.61	--
F2004	0.01	1.82	0.01	1.03	0.01	3.75
FMSY	0.20	--	0.20	--	0.20	--
F2004/FMSY	0.03	1.82	0.03	1.03	0.04	3.75
Pup-survival	0.82	0.29	0.82	0.29	0.83	0.30
alpha	2.64	--	2.64	--	2.68	--
steepness	0.40	--	0.40	--	0.40	--

6. Continuity

- Used model from 2002
- Used same catches, *similar* indices
- Used same selectivities
- Used 2002 biological parameters
- **NOTE: 2002 was single-stock assessment**

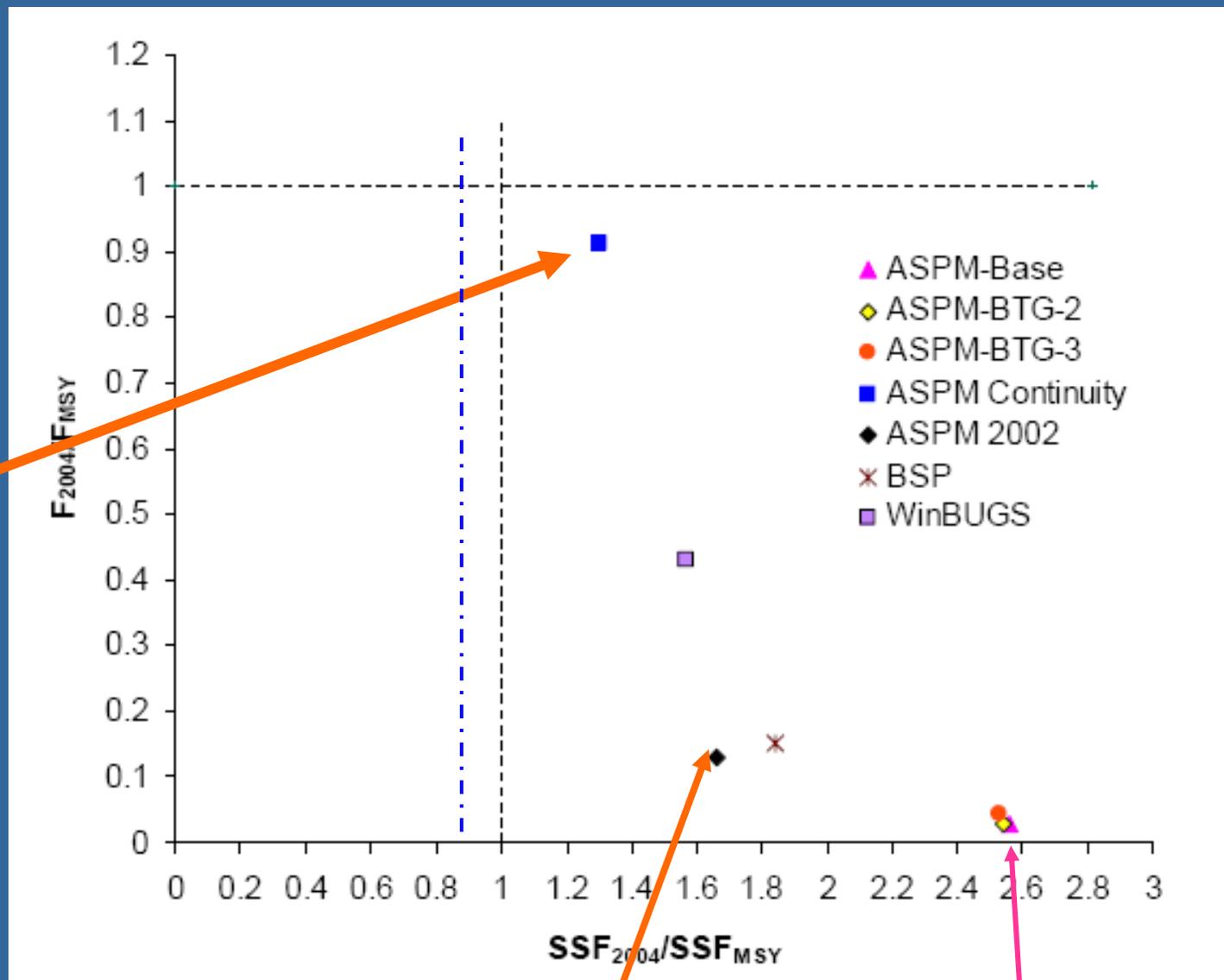
6. Continuity

- 2002 vs 2006 indices:
 - Nominal 2002 vs Standardized 2006
 - Split series 2002 vs Single Standardized 2006
 - Indices for Gulf/Atl together in 2002, Gulf/Atl separate in 2006

6. Continuity Result

- $SSF_{2004}/SSF_{MSY} = 1.30 \rightarrow$ **NOT** overfished
- $F_{2004}/F_{MSY} = 0.91 \rightarrow$ **NO** overfishing
- Steepness = 0.31
- $SPR_{MSY} = 0.75$
- $F_{MSY} = 0.06$

Contin.
case

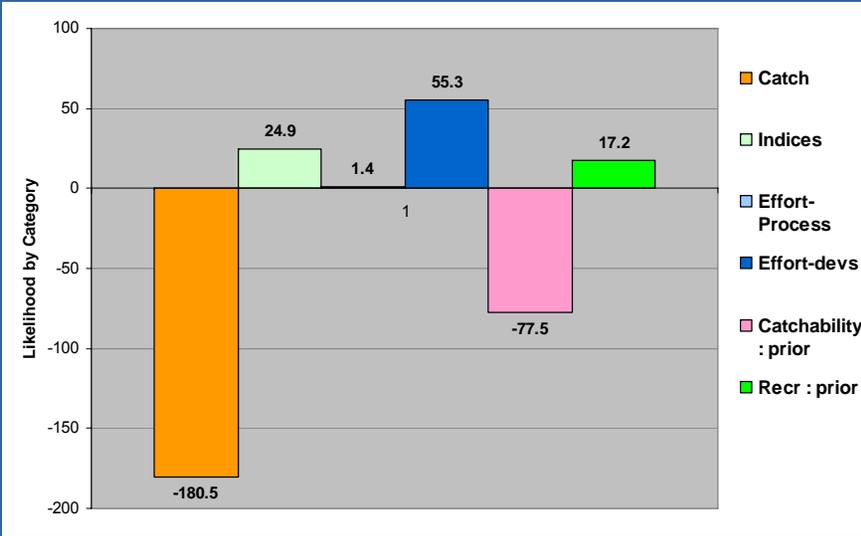


BASE
2002

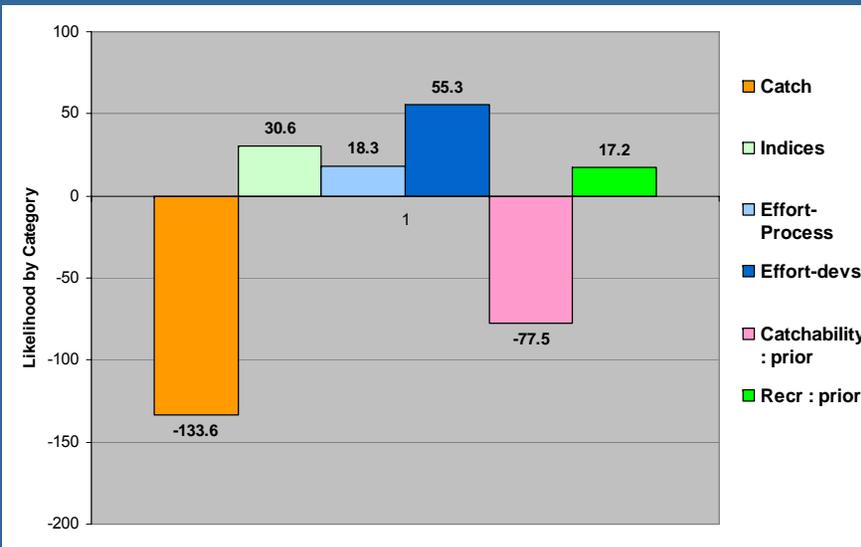
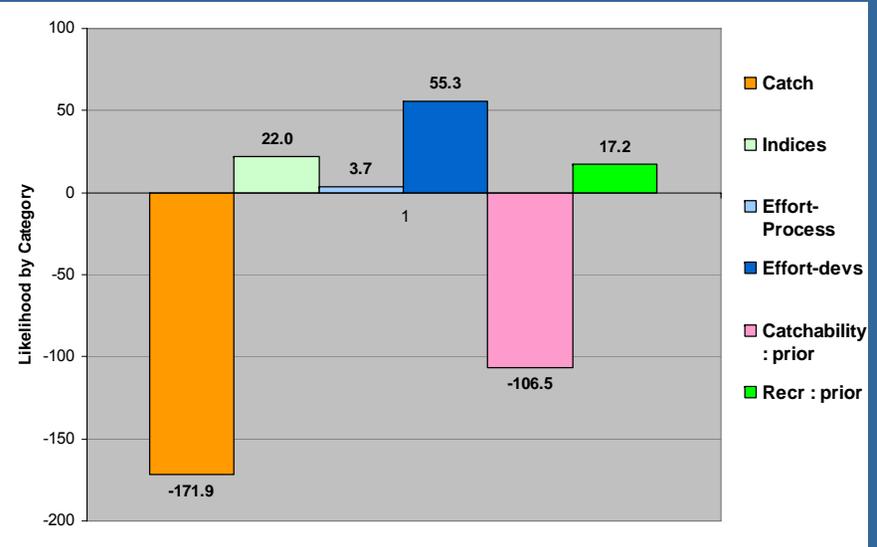
BASE
2006



BASE

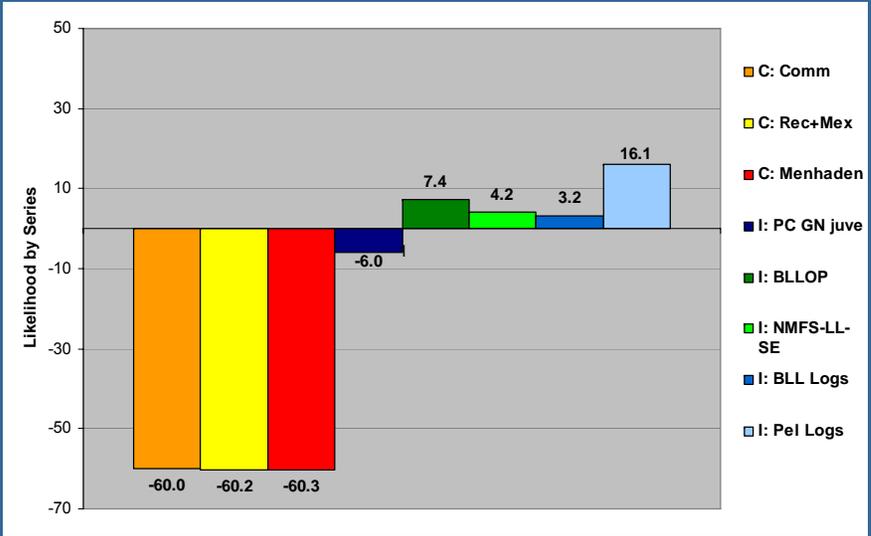


BTG-2 all indices

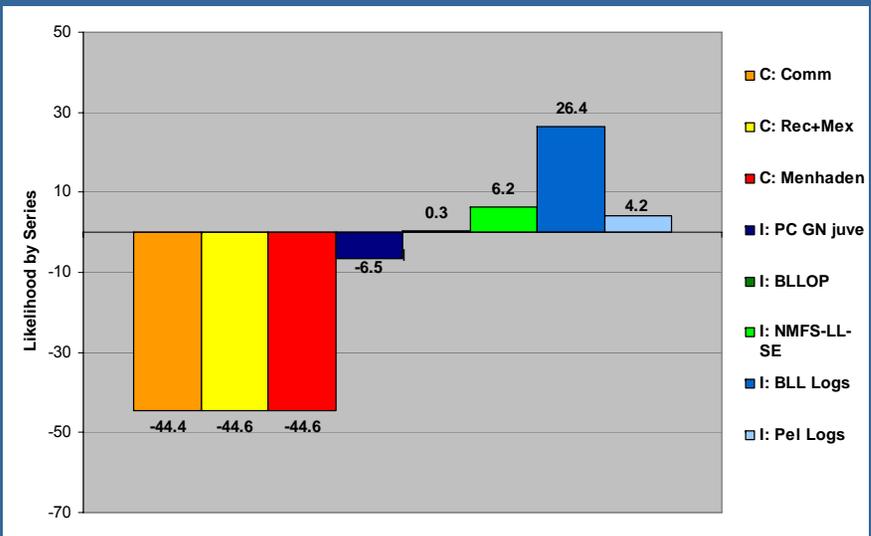
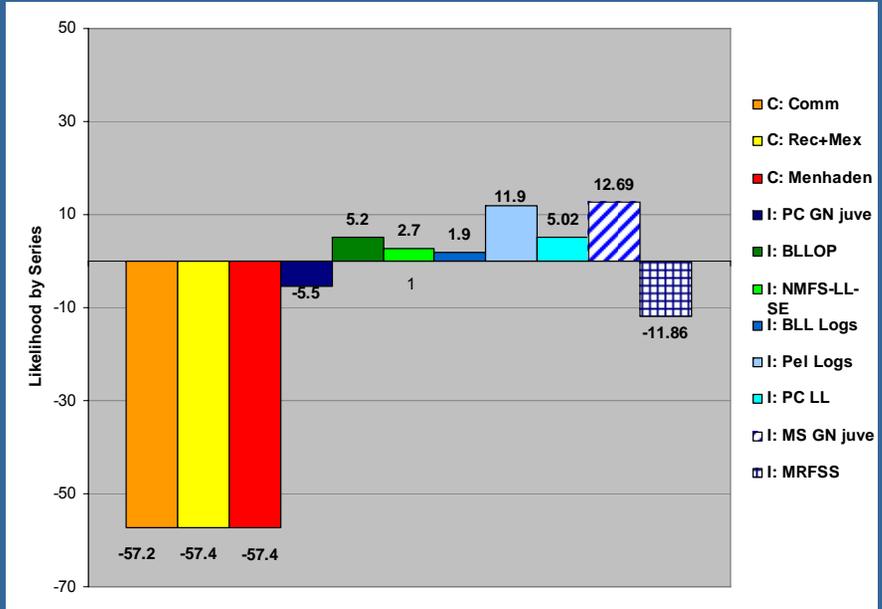


BTG-3 inv. CV

BASE



BTG-2 all indices



BTG-3 inv. CV

BT Gulf – Run Request

- Try to get posterior for BASE run
 - Ran overnight, but not complete by 8:15 am

BT Gulf – Run Request

- Blacktip Gulf 2006 Base model
- Use 3 indices only: BLLOP
- No Hessian obtained