Setting and reaching management goals under a changing climate

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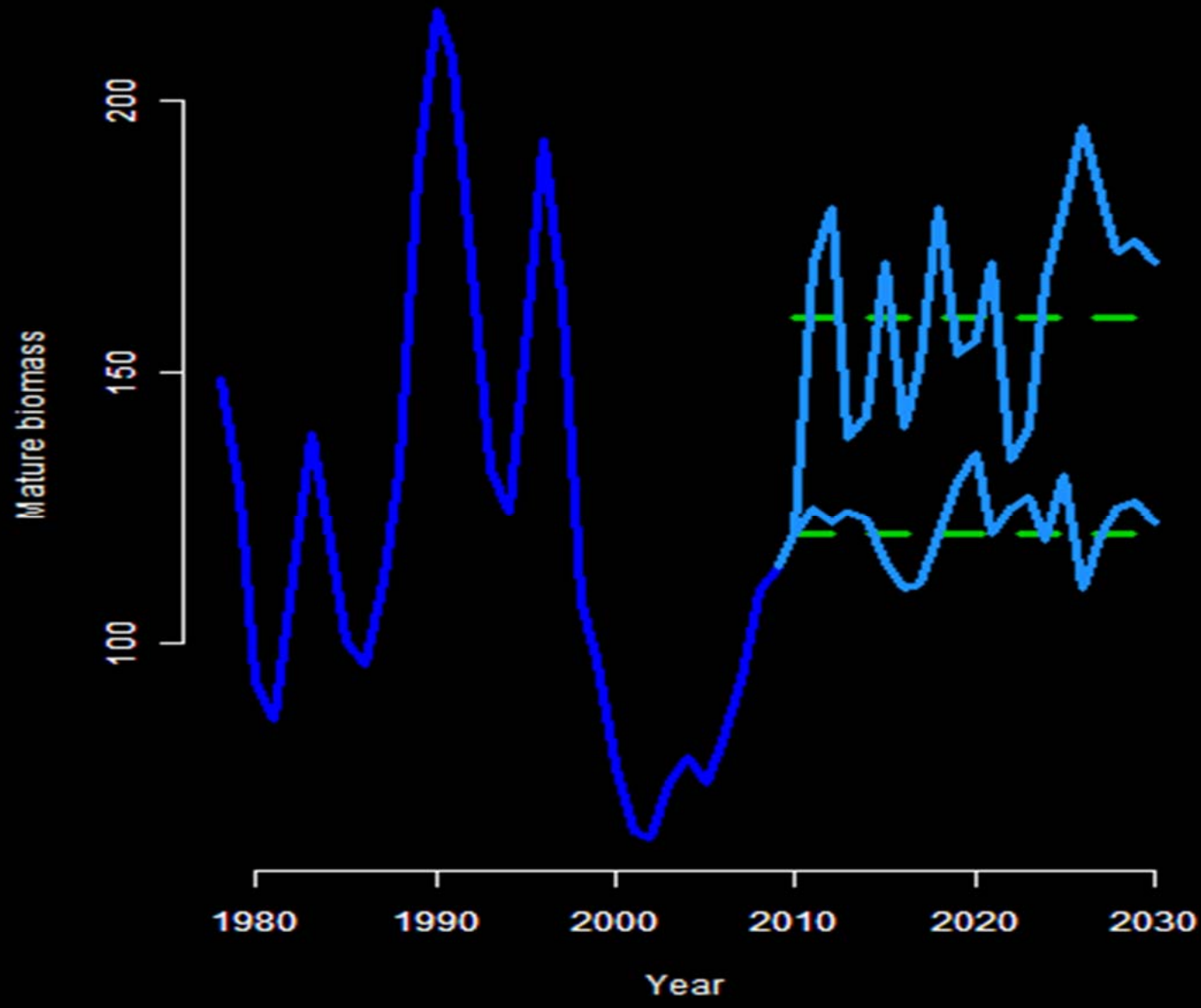
Recruitment and fisheries management

Climate change and recruitment

How can management account for change?

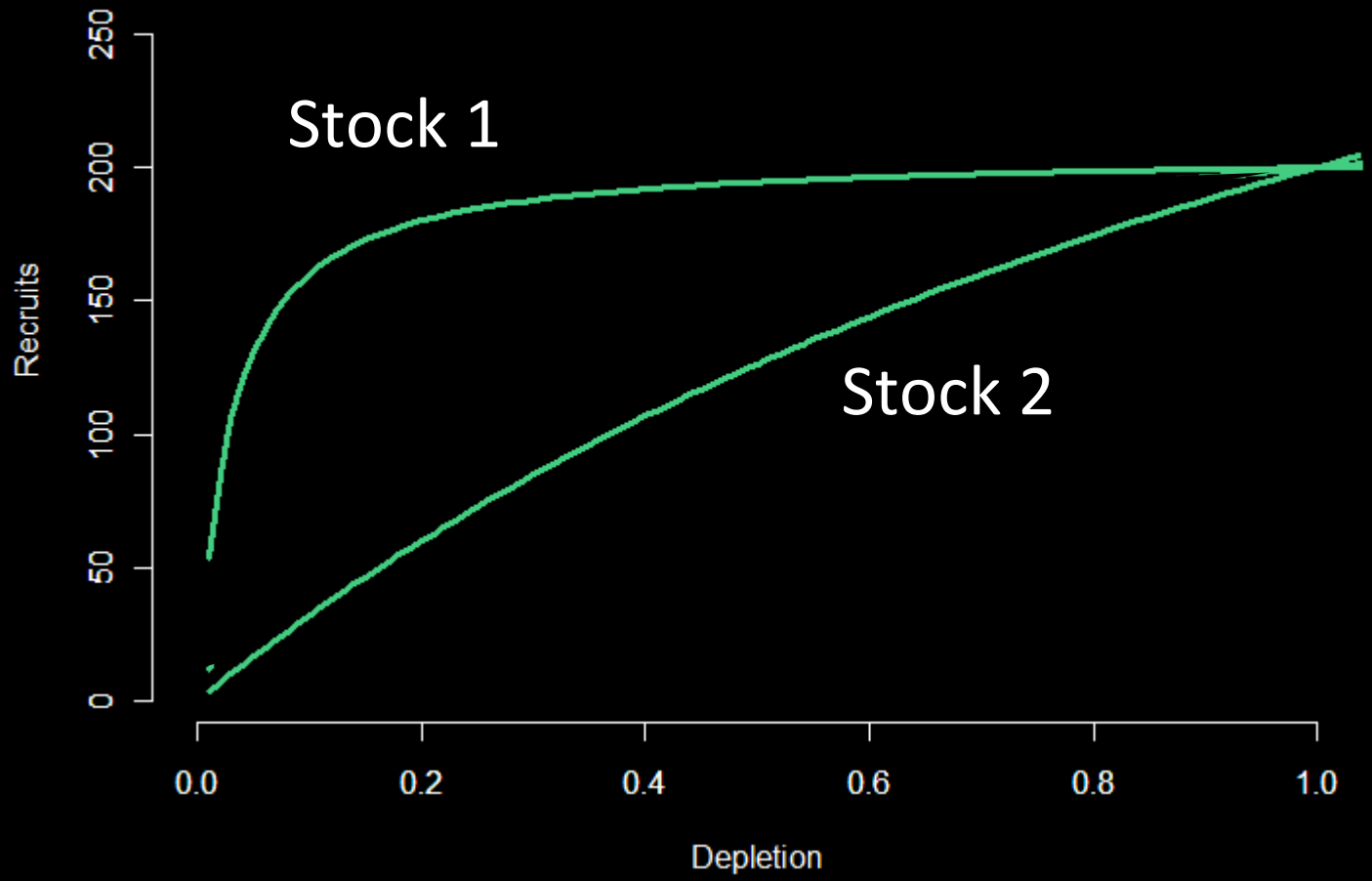
How are fisheries managed?



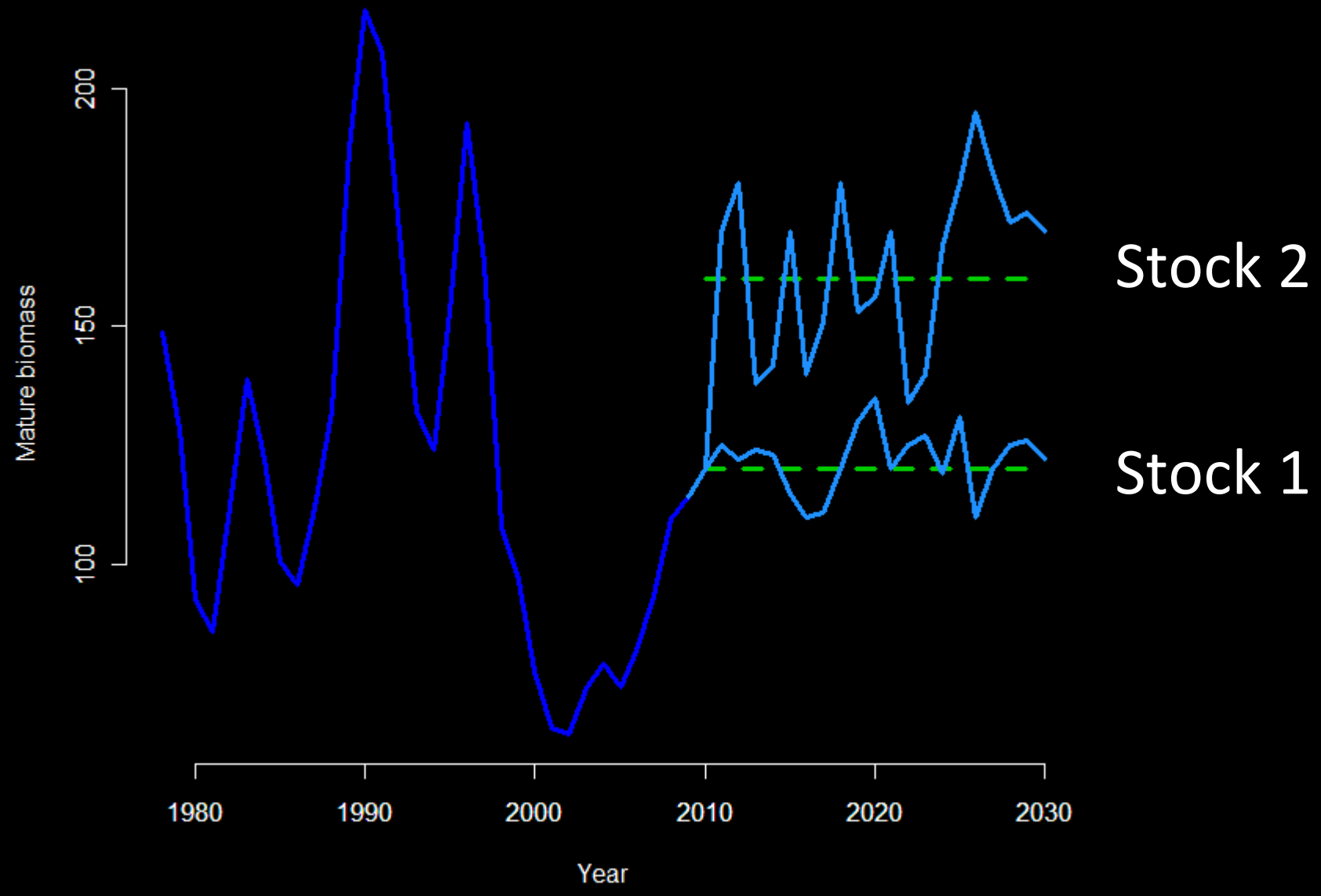
Target Biomass 1

Target Biomass 2

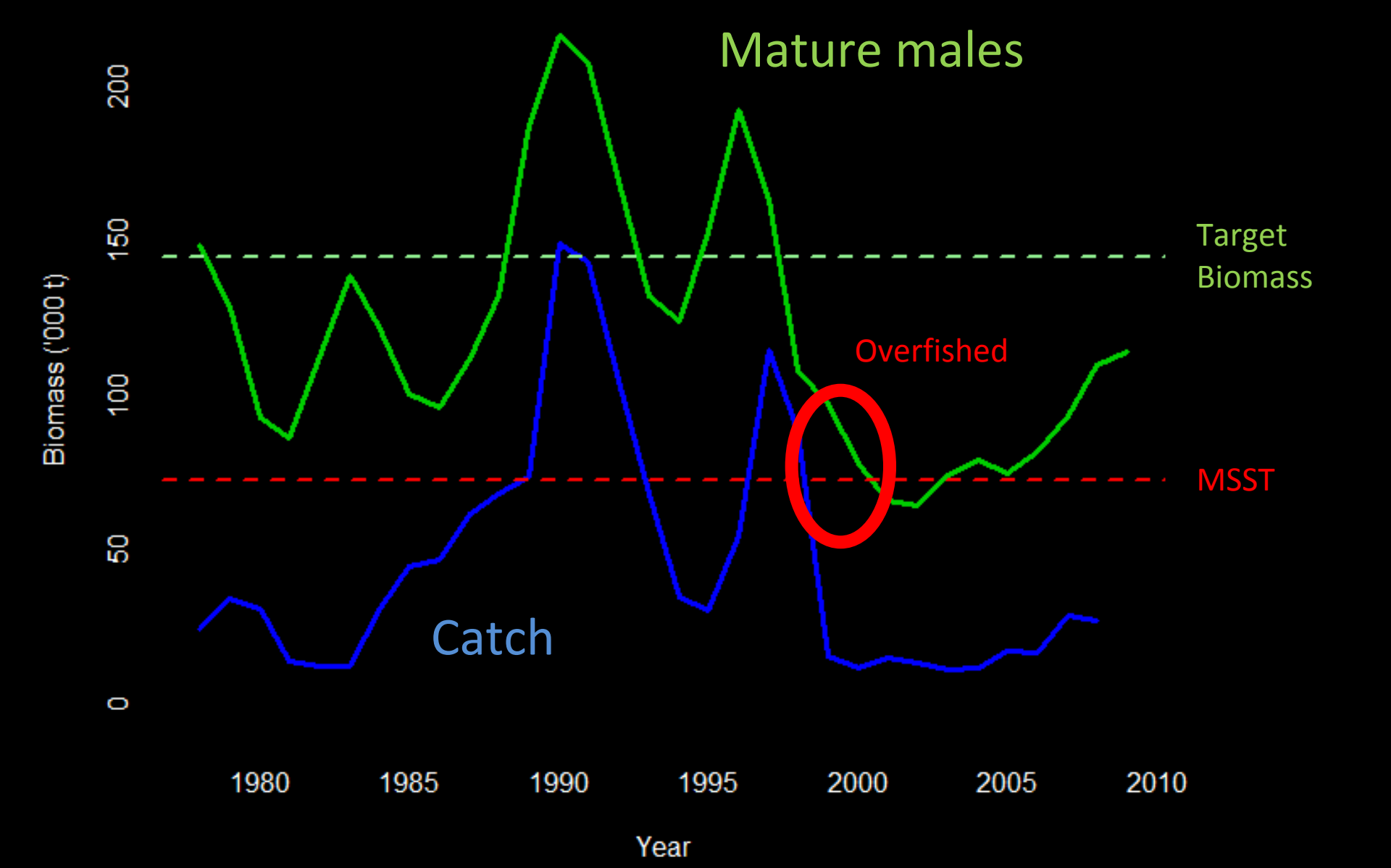
Depletion vs recruitment



Assumptions about recruitment are important!



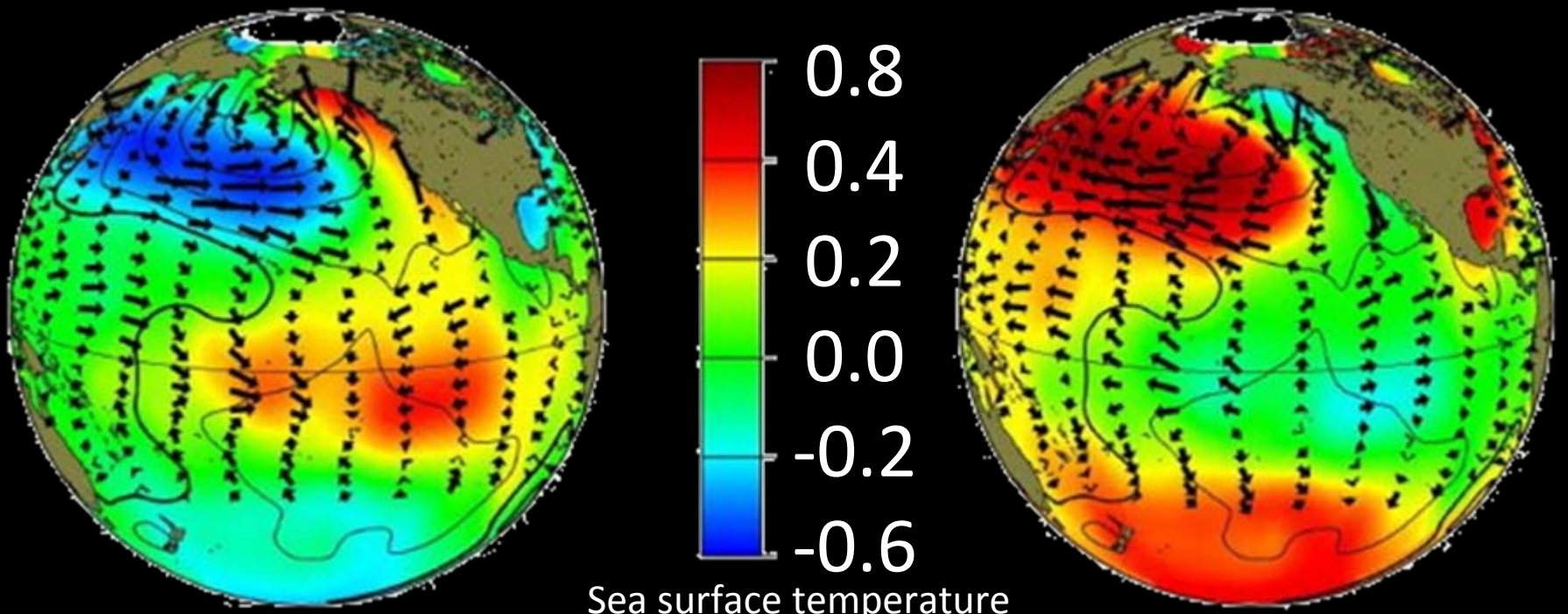
Alaska CamSled



TARGET BIOMASS = SBPRF35% x Average Recruitment

How can climate change influence recruitment?

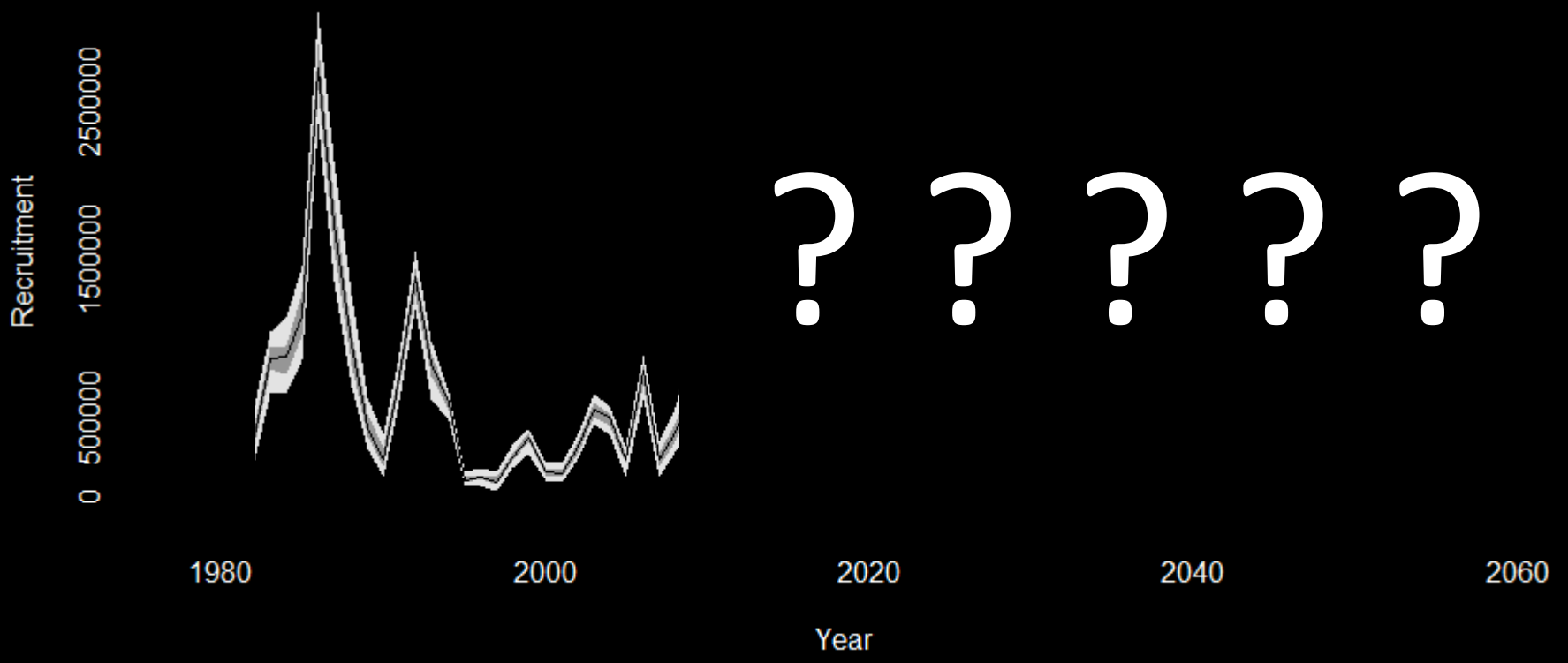
Pacific Decadal Oscillation



Sea surface temperature anomalies

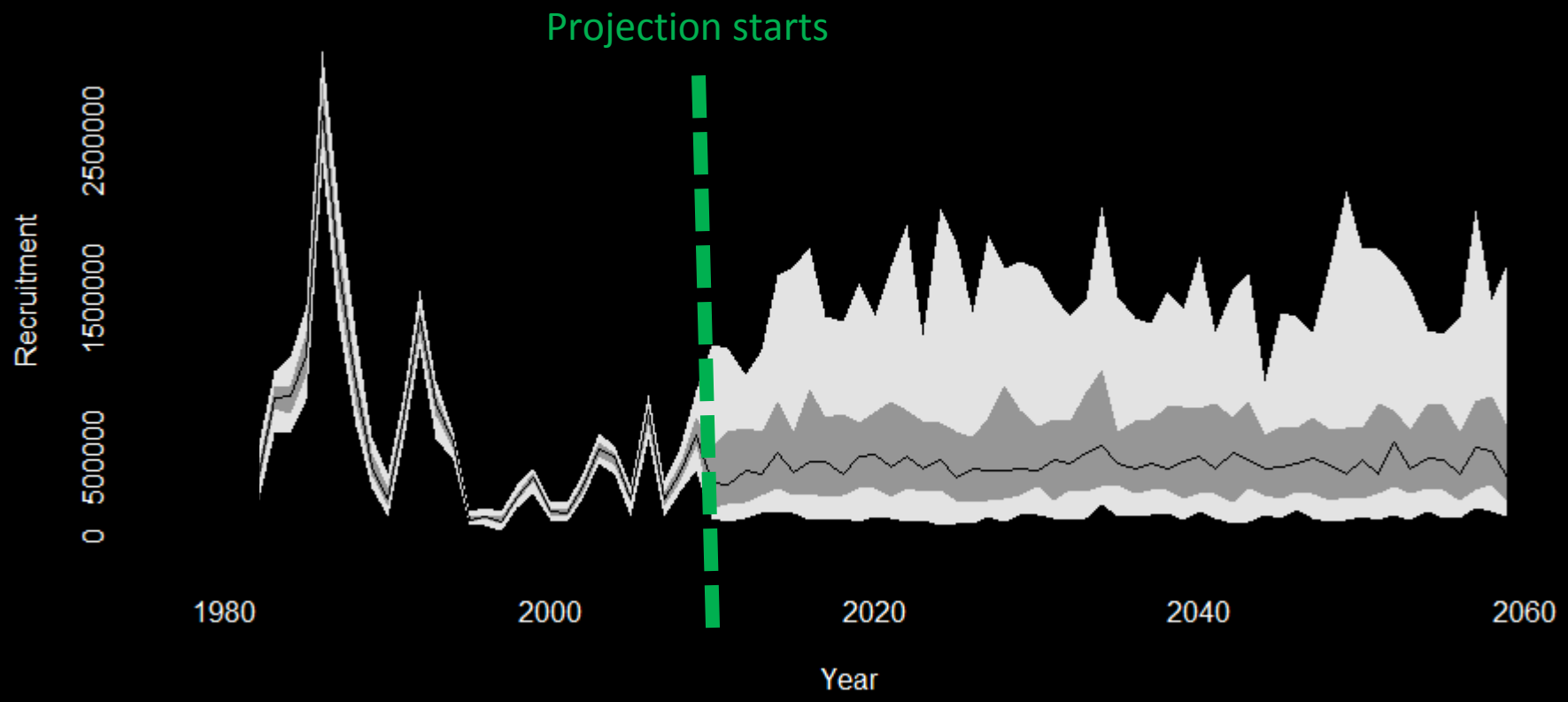
Sockeye salmon (Adkison et al 1998)
Pollock (Hunt, 2002,2011)
Salmon, turbot, Alaska plaice, groundfish, etc (Hare and Mantua, 2000)
Flatfish (Wilderbuer et al, 2002)

Snow crab recruitment



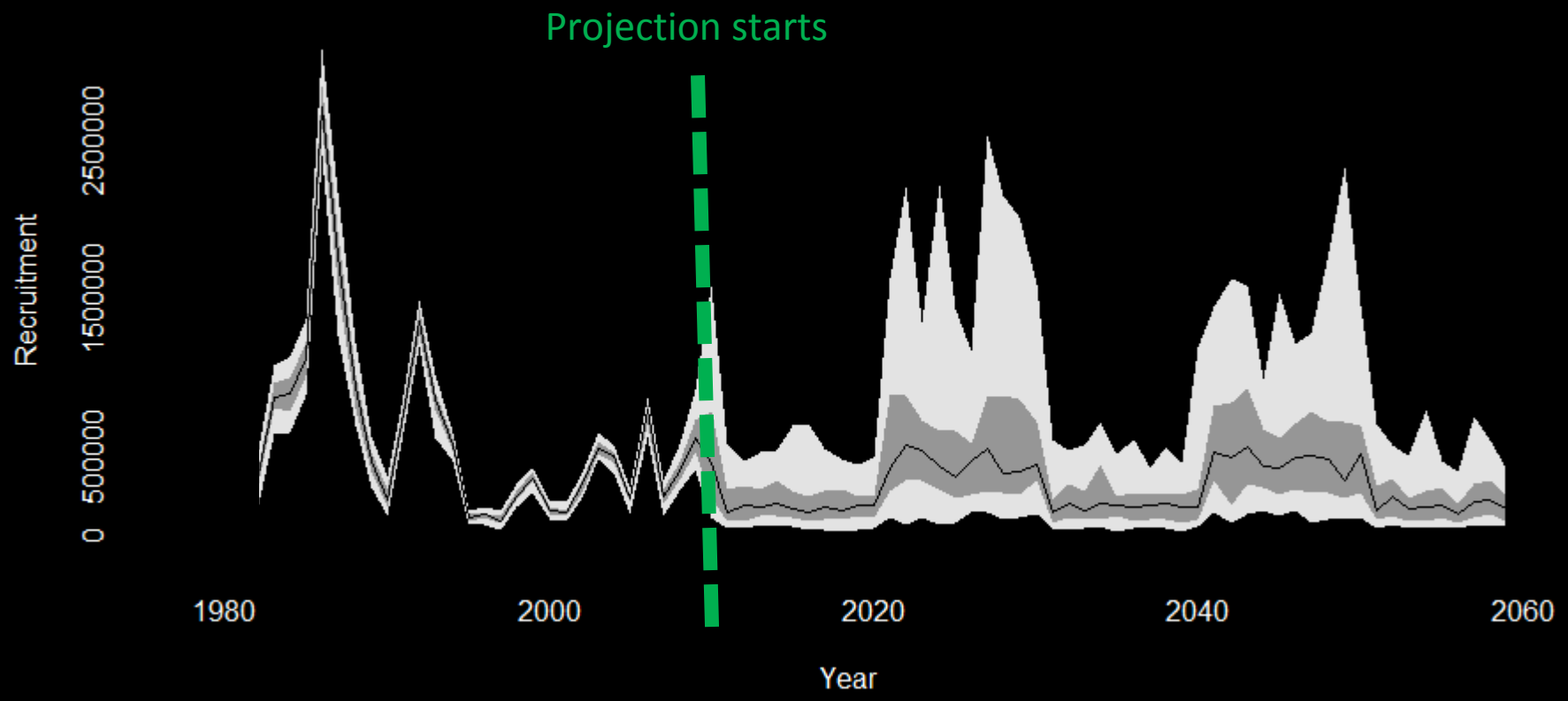
Projected

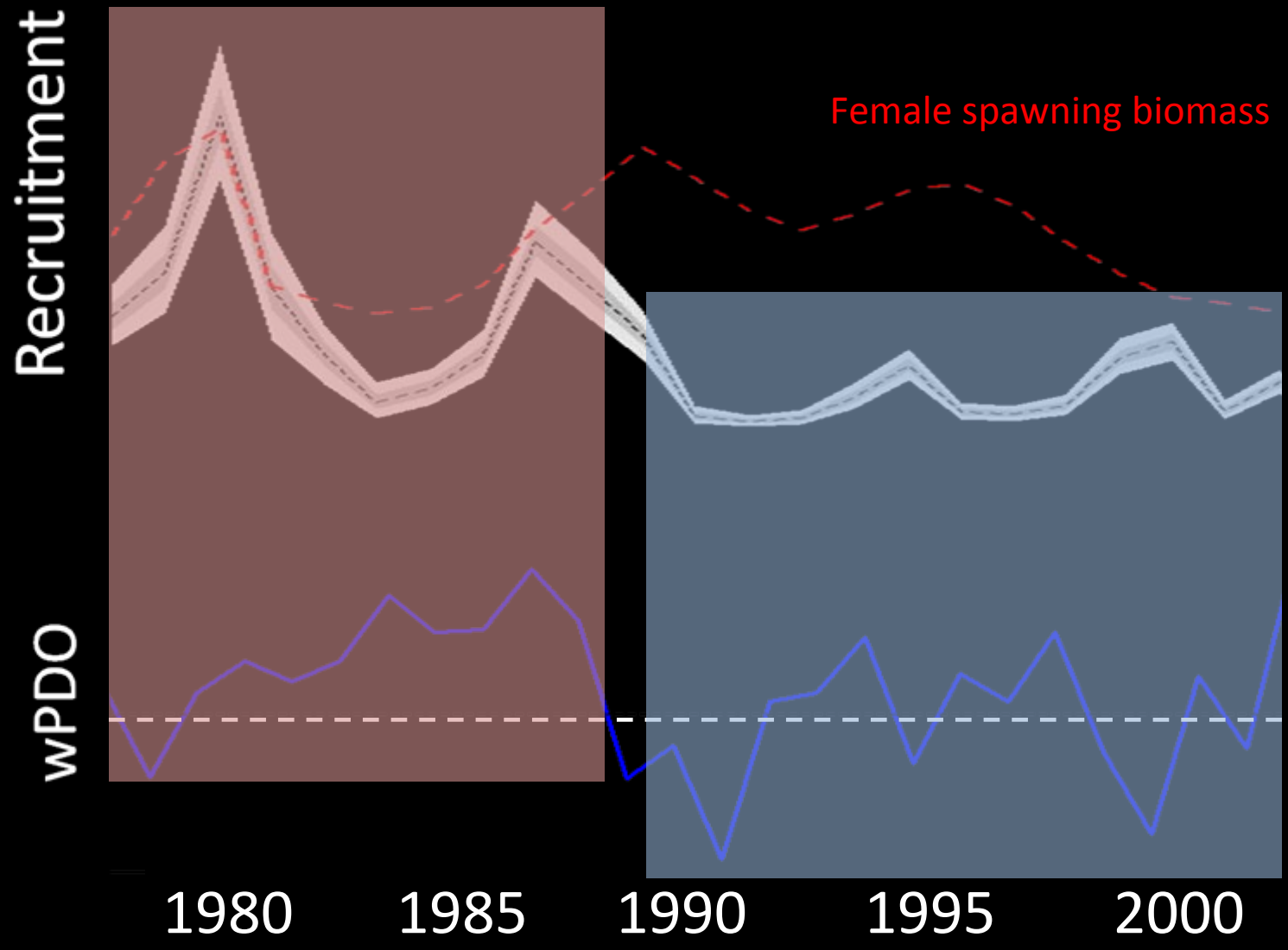
Status quo recruitment



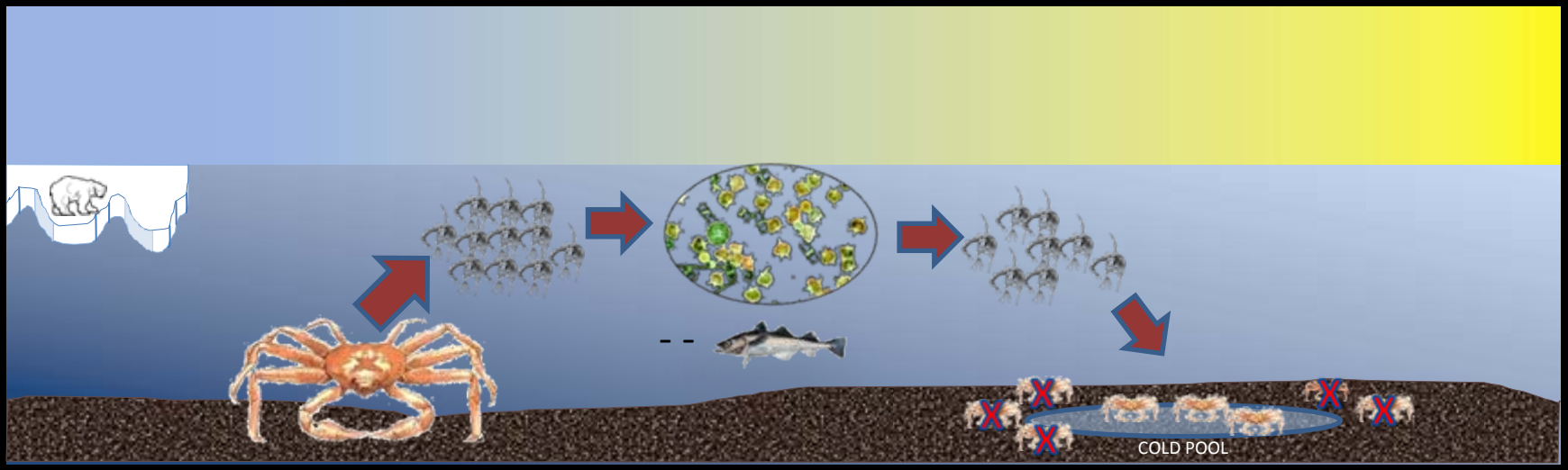
Projected

Regime-based recruitment

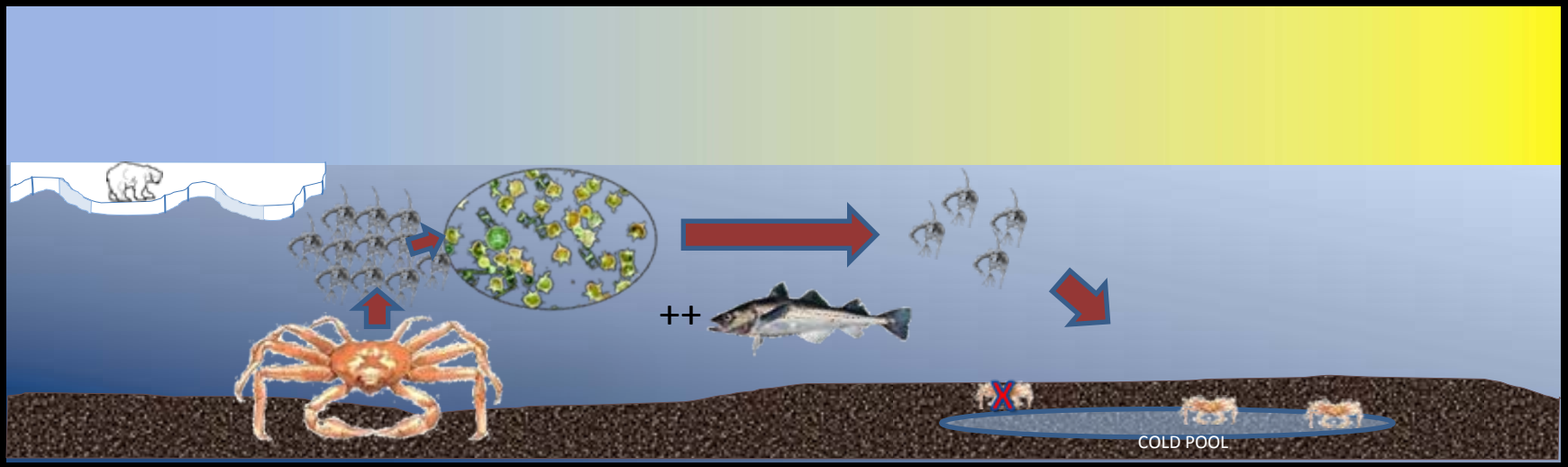



Recruitment
Female spawning biomass
wPDO
1980
1985
1990
1995
2000

Warm Regime: Early ice retreat, late bloom, high productivity, small cold pool.



Cold Regime: Late ice retreat, early bloom, low productivity, large cold pool.

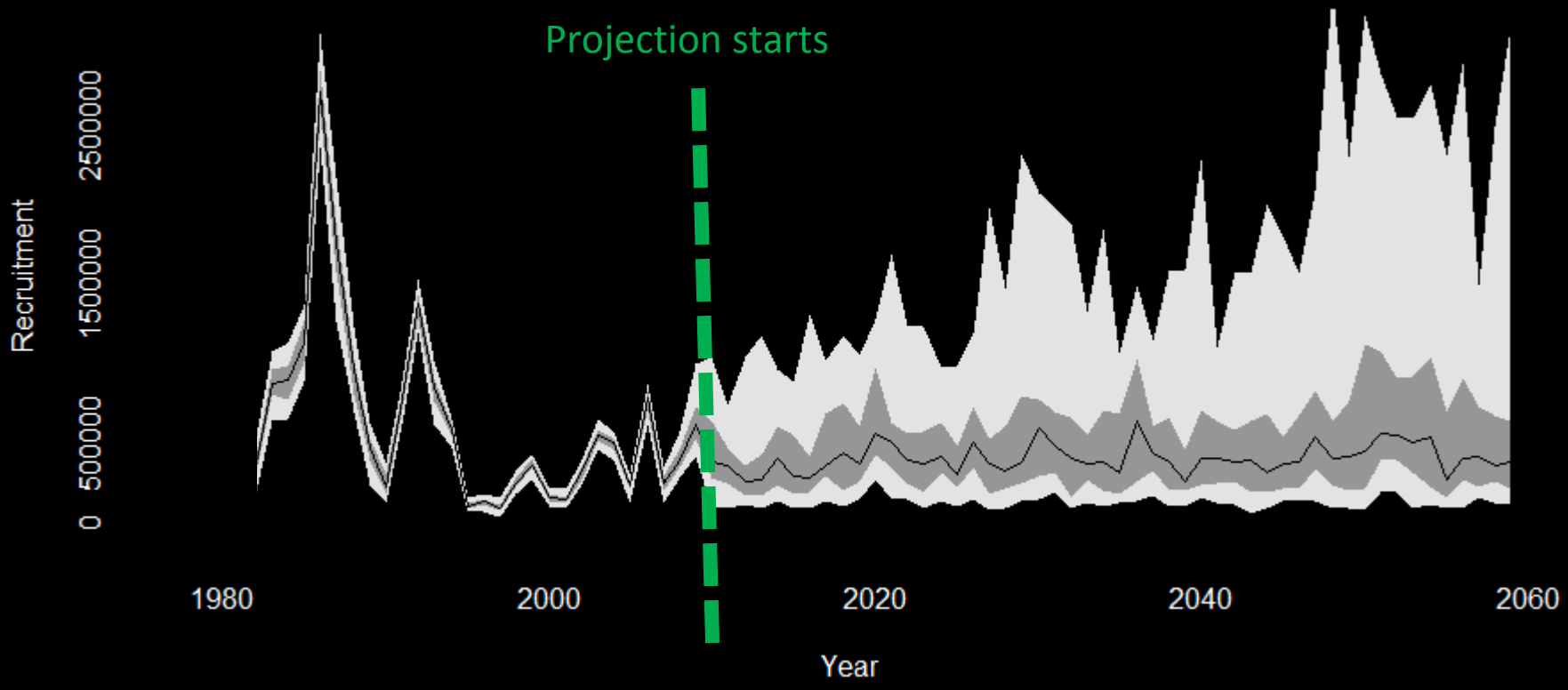


March April May June July August

Szuwalski and Punt (in review), “Oscillating control and regime shifts: a model for snow crab recruitment in the eastern Bering Sea.”

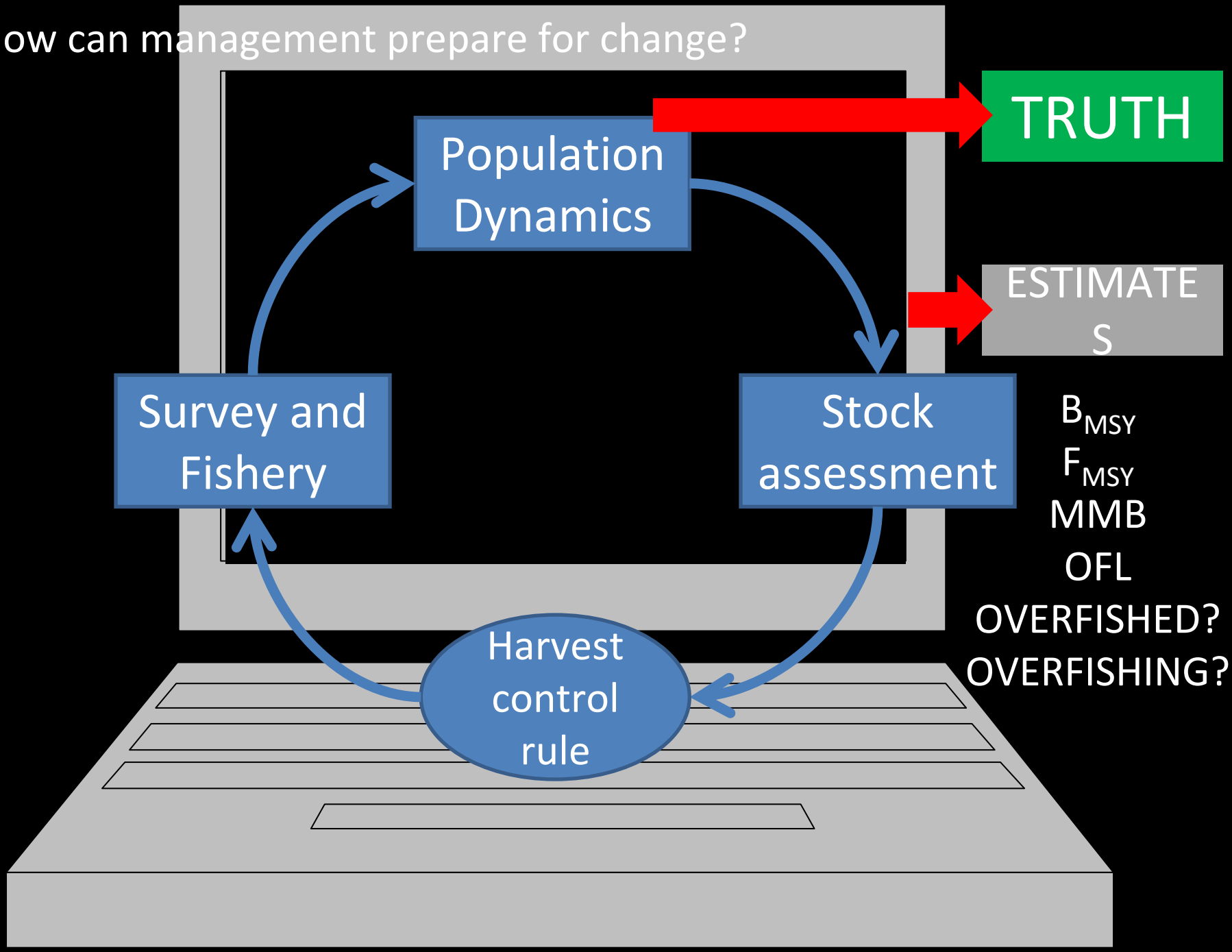
Projected

Oscillating control recruitment

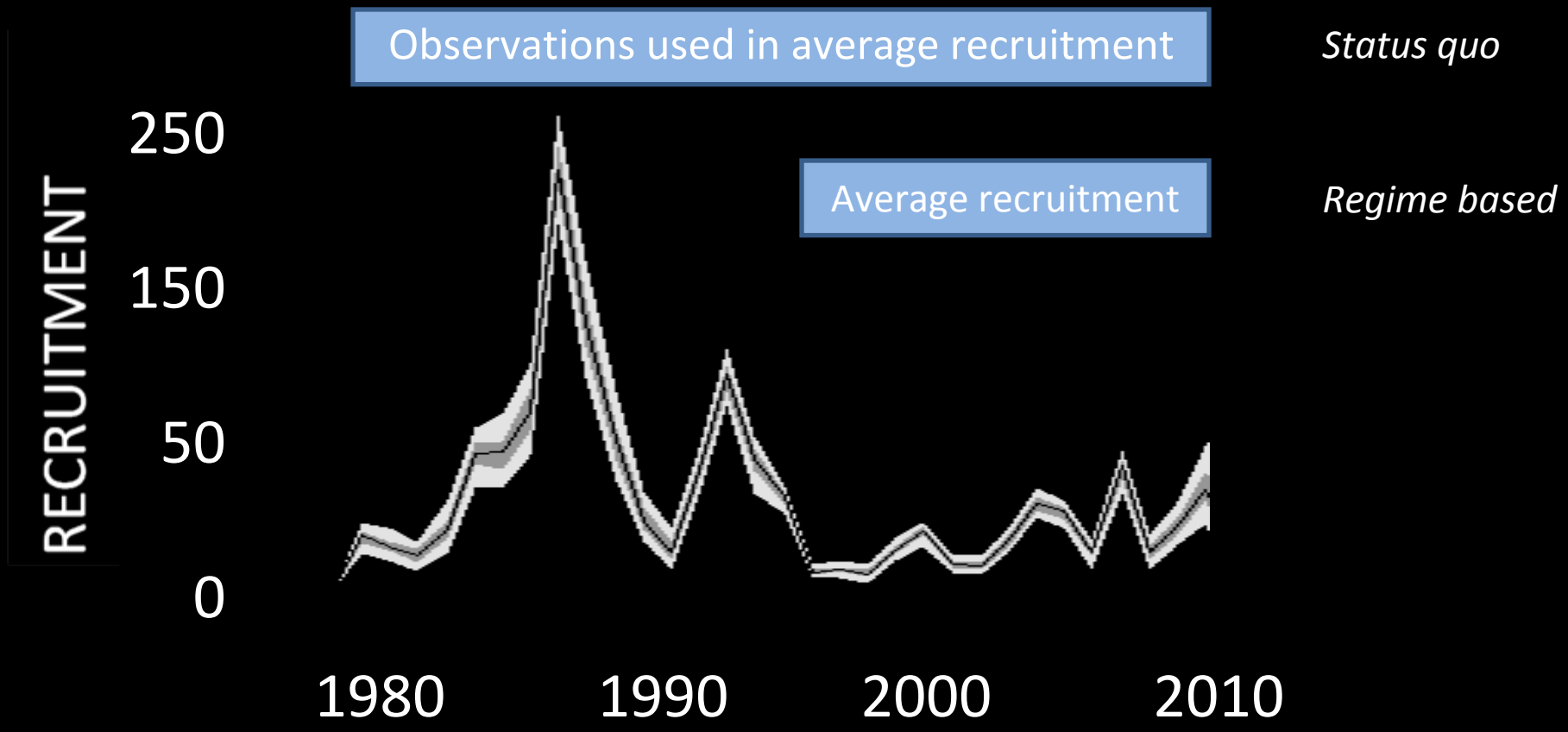


Wang and Overland (2010), “Climate projections for selected LMES”
Hollowed et al (2009), “A framework for modeling fish and shellfish response to future climate change”

How can management prepare for change?



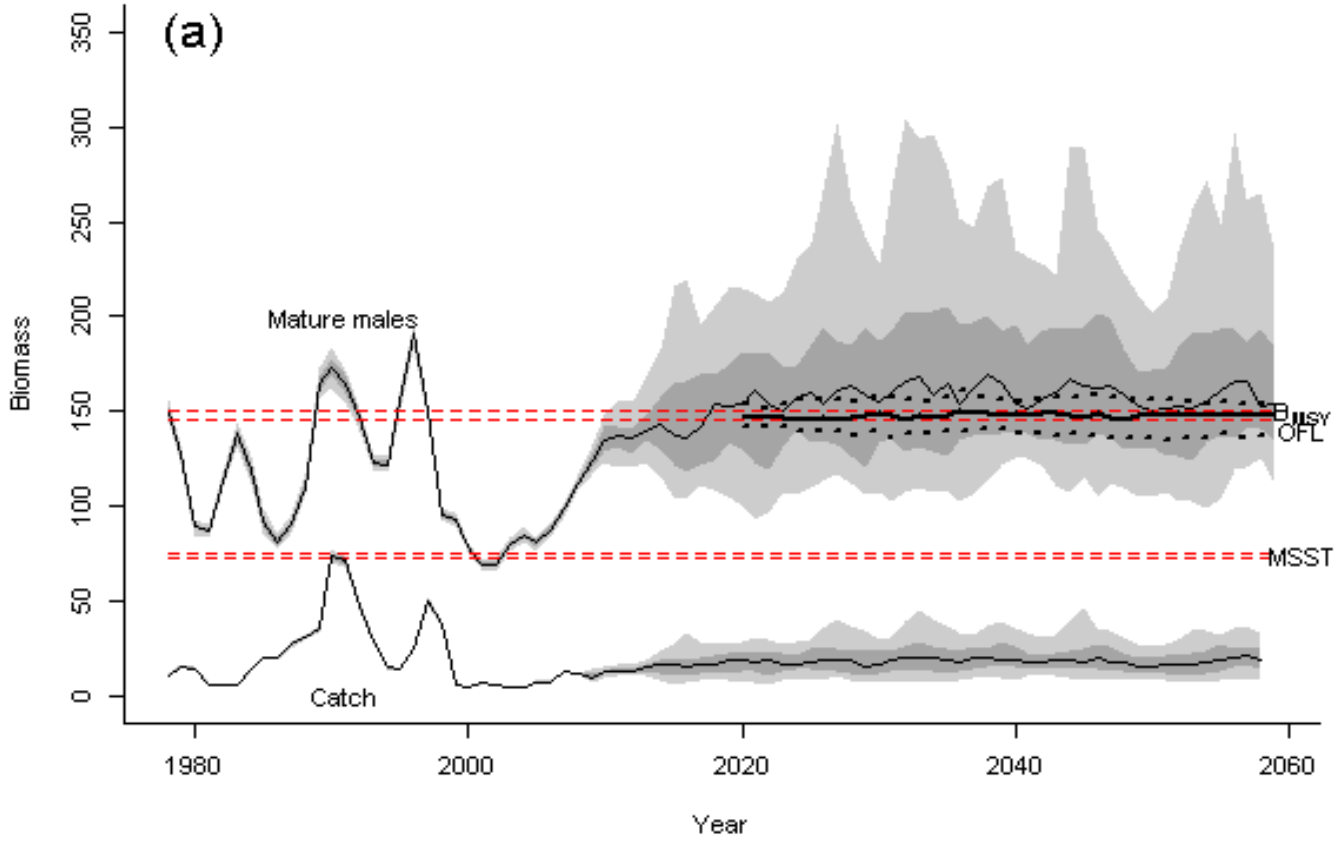
Target biomass = SBPRF35% x Avg Recruitment

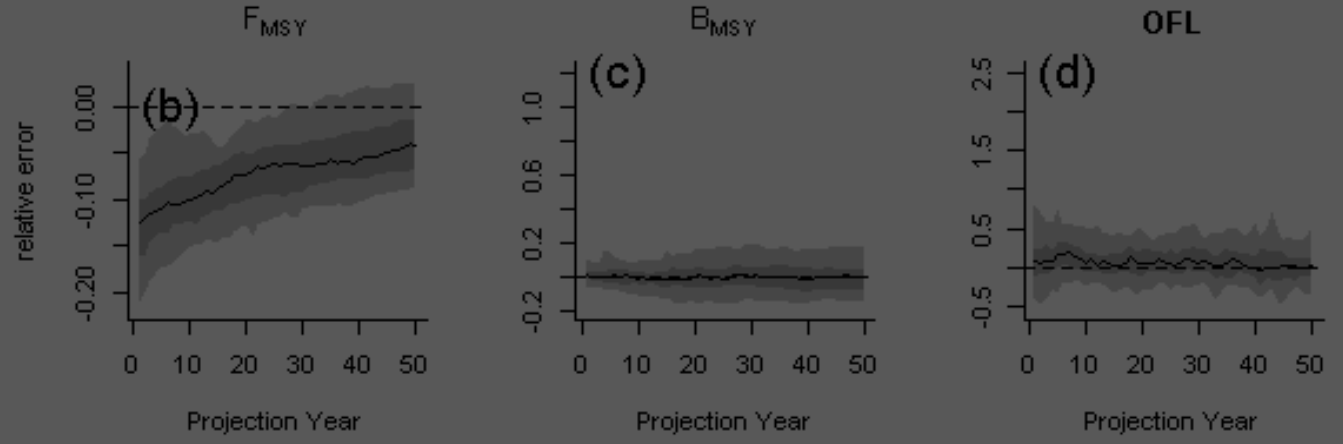


Ianelli et al, 2011. “Evaluating management strategies for walleye Pollock in the EBS under a changing environment.”
A’mar et al, 2009. “The evaluation of two management strategies for the GOA pollock fishery.”

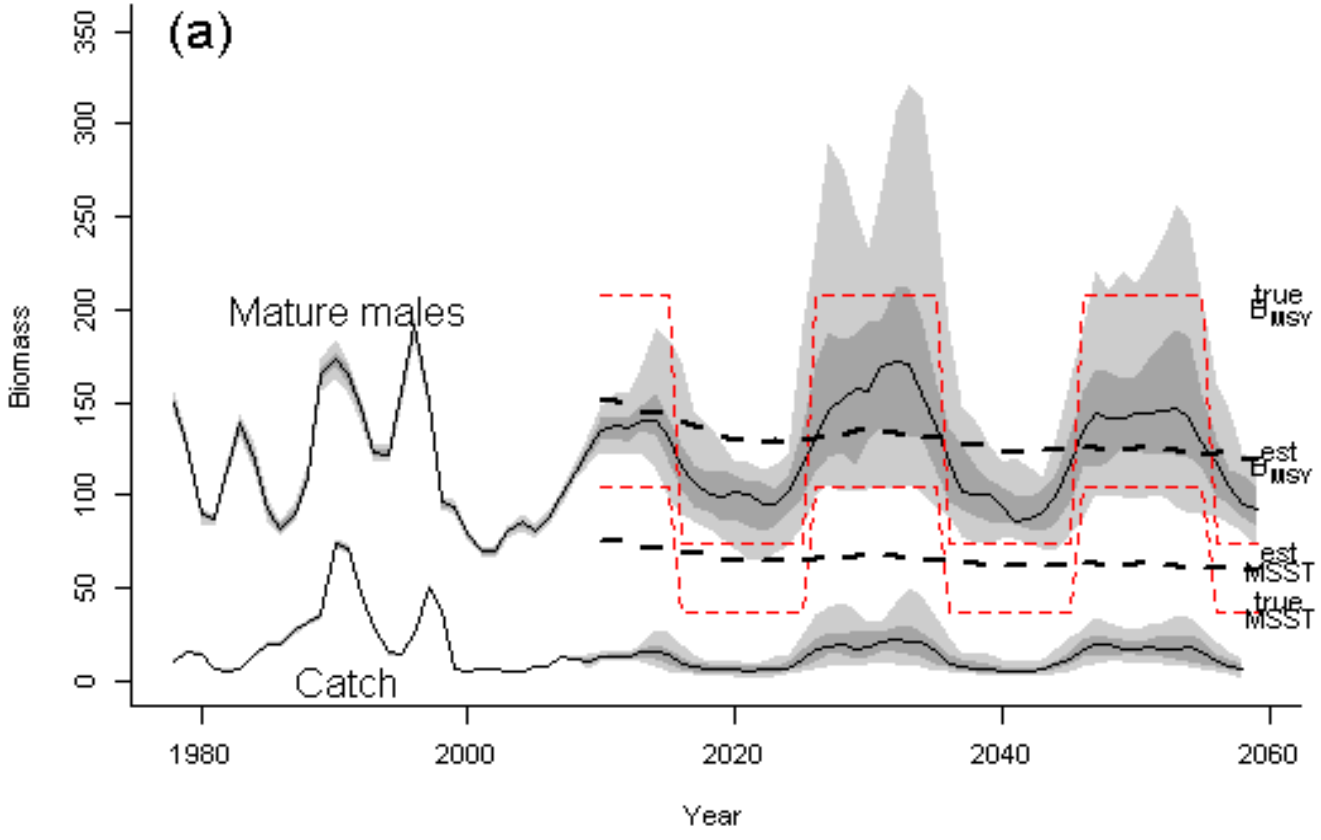
Population Dynamics	Assessment methods
Status quo	Status quo
Regime-based	Status quo
Oscillating control	Status quo
Status quo	Regime-based
Regime-based	Regime-based
Oscillating control	Regime-based

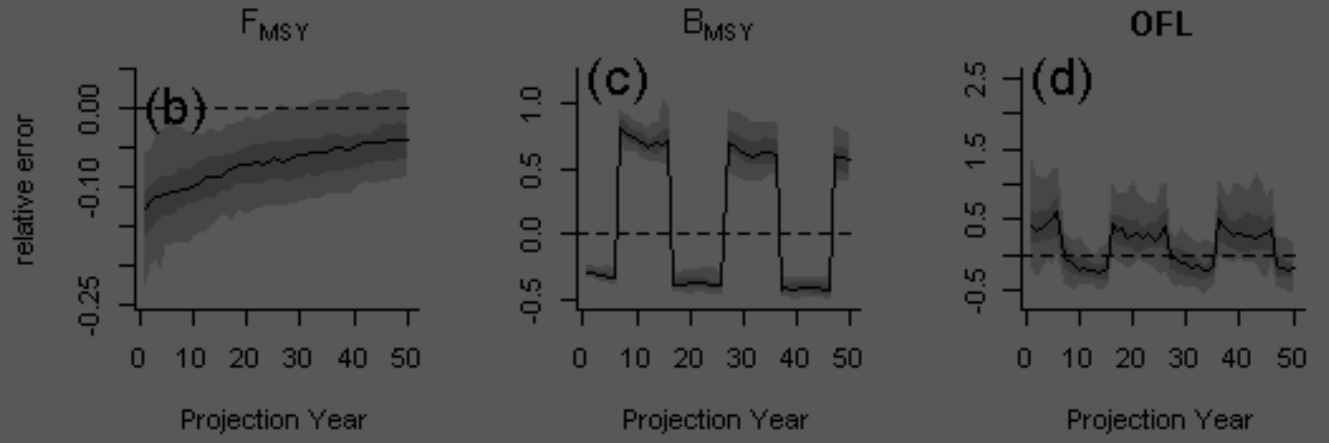
Status quo recruitment; status quo assessment



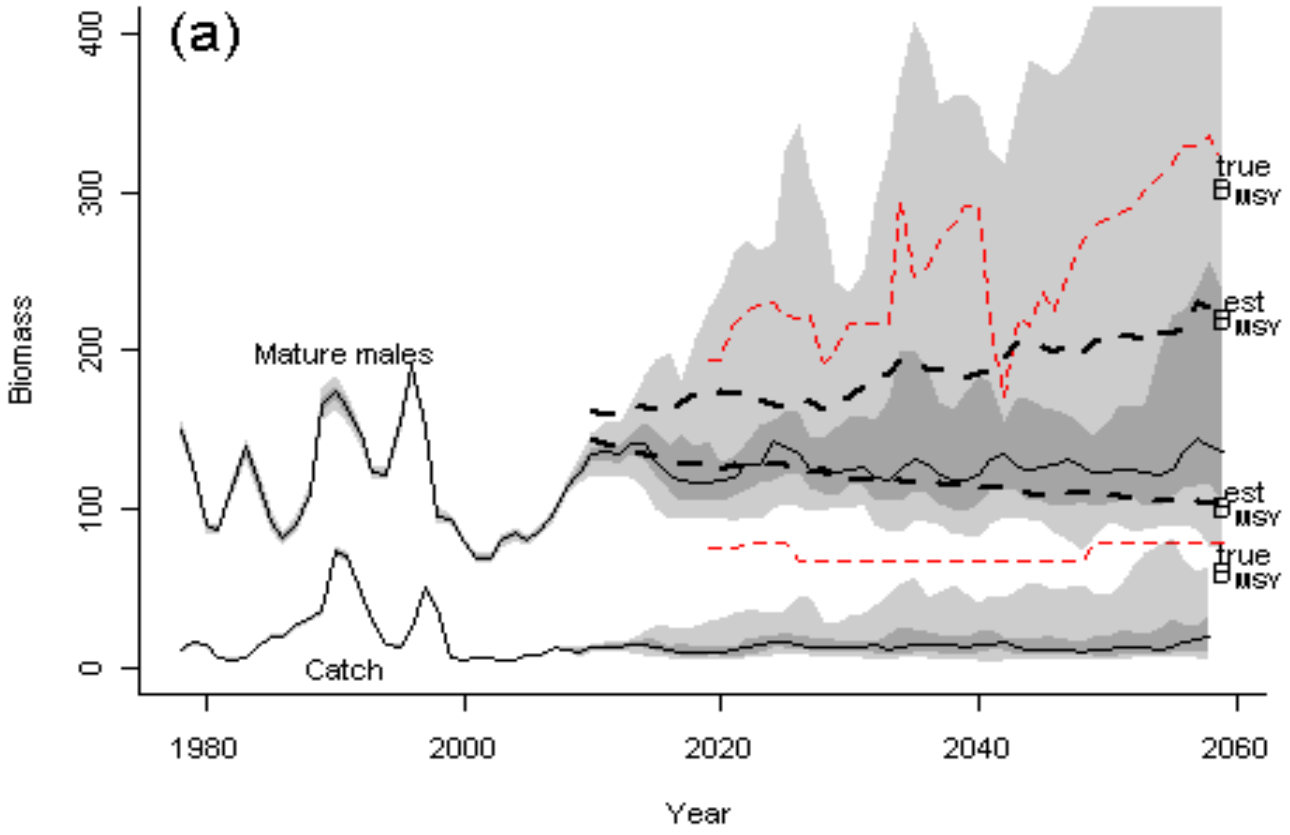


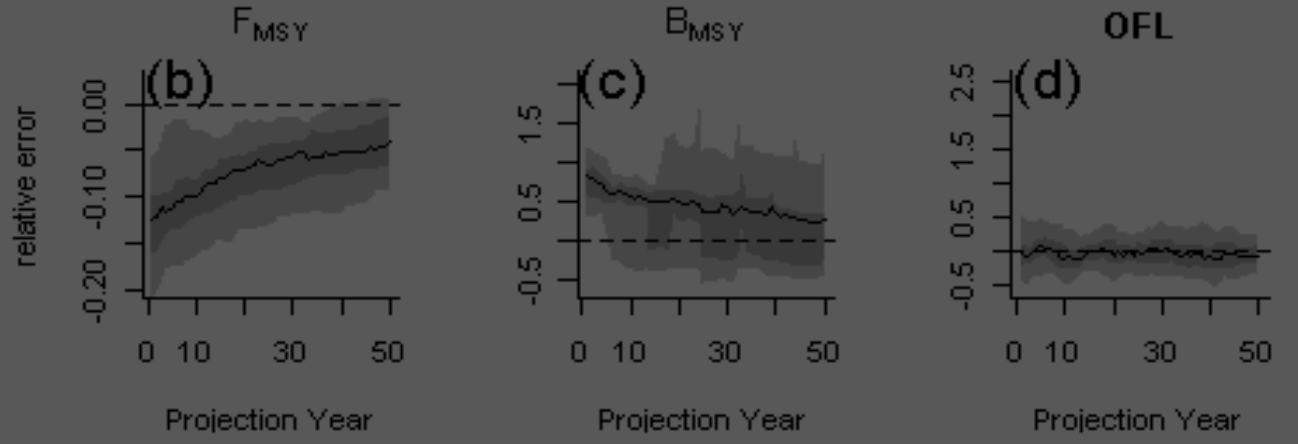
Regime-based recruitment; status quo assessment



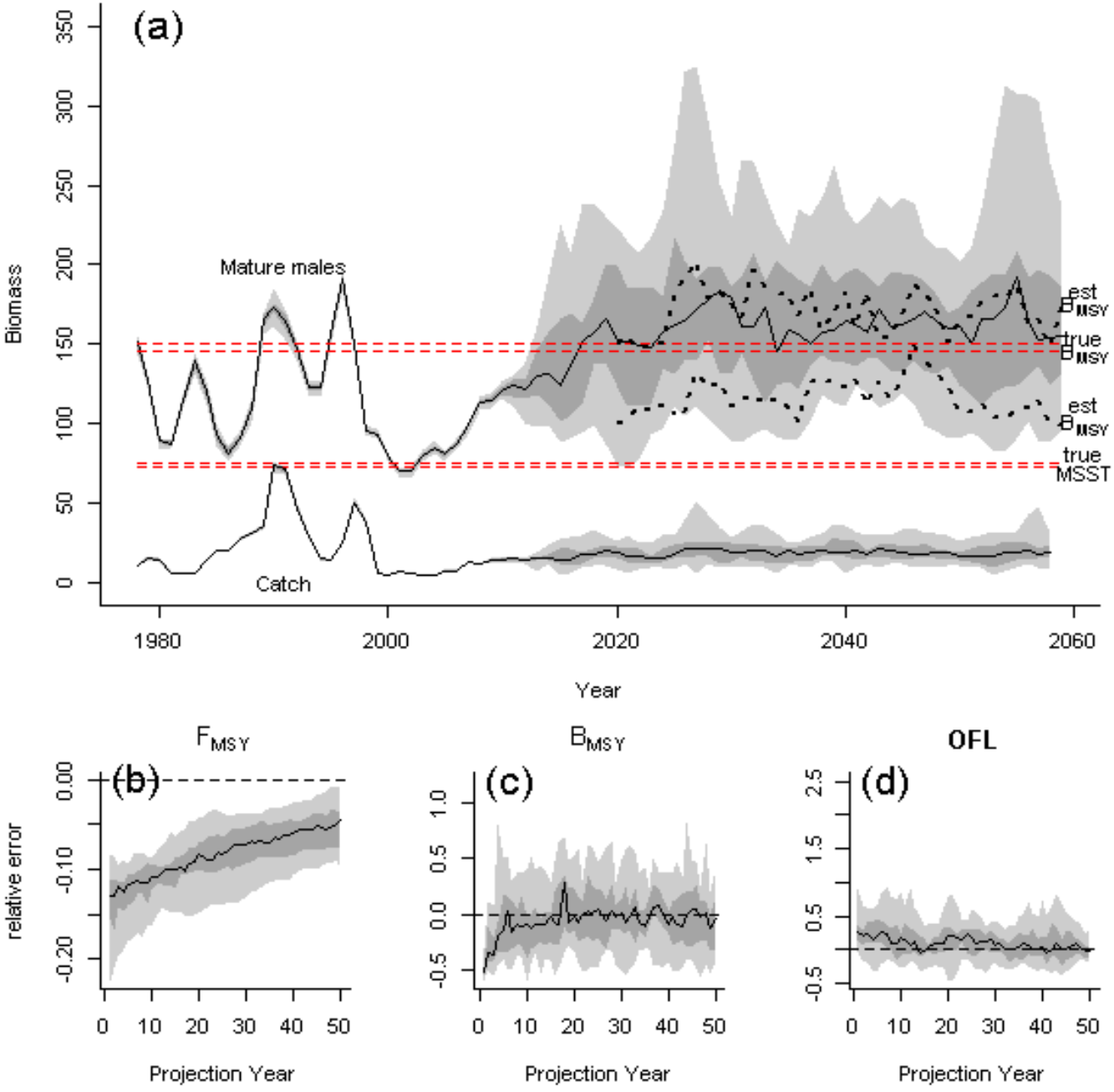


Oscillating control; status quo assessment

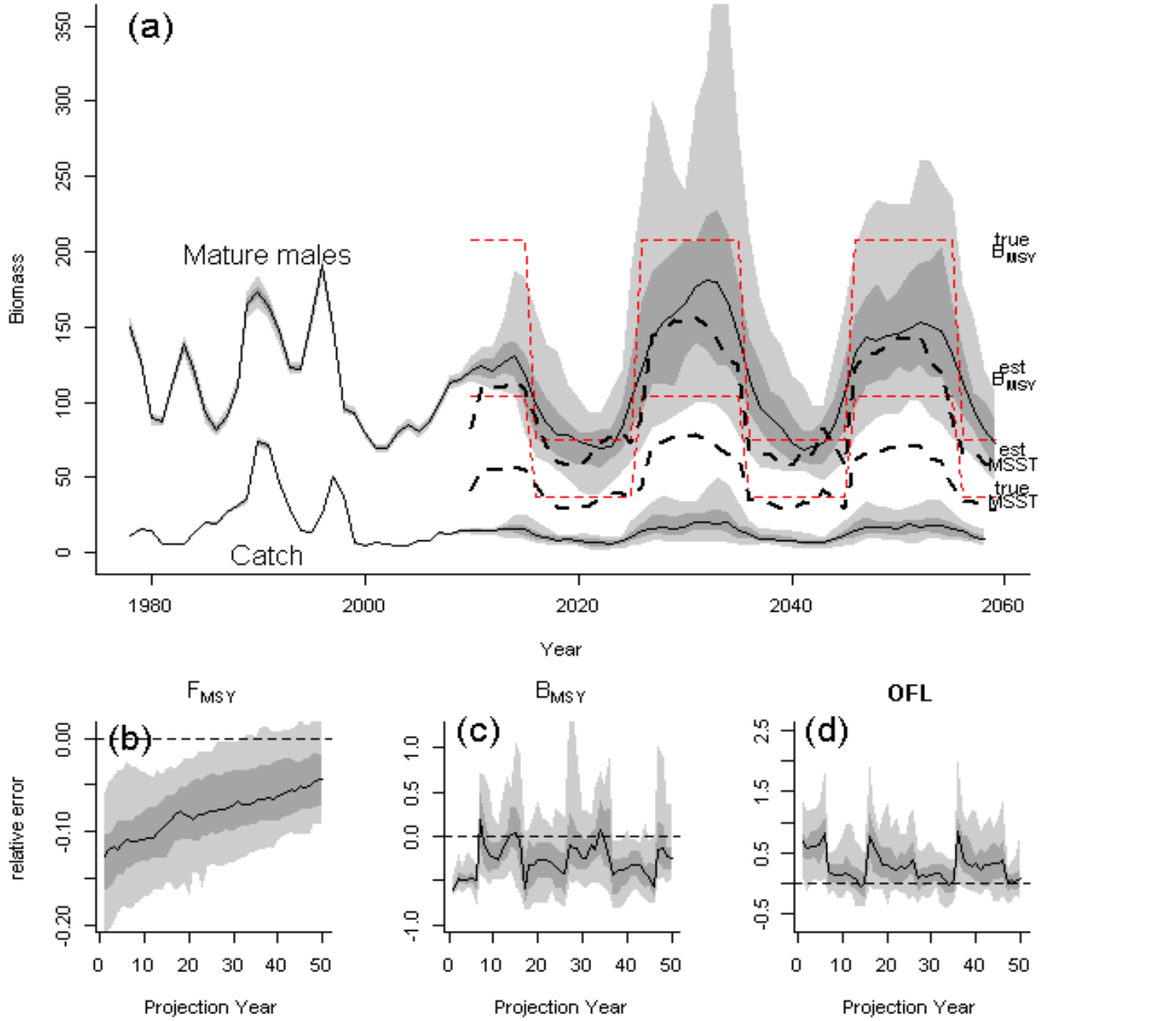




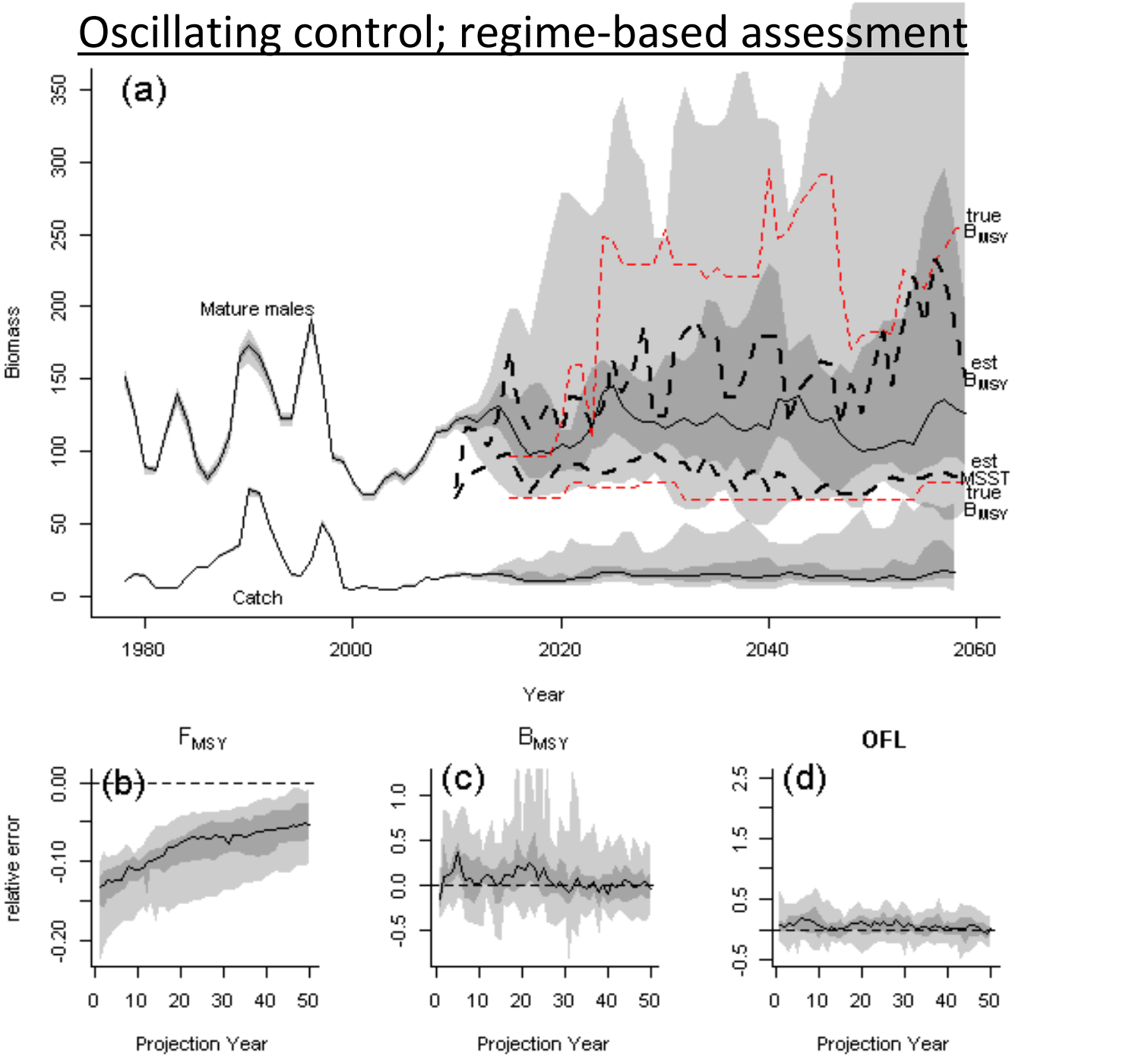
Status quo recruitment; regime based assessment



Regime-based recruitment; regime-based assessment



Oscillating control; regime-based assessment



Conclusions

Targets must be set carefully for stocks that are environmentally driven.

Management strategy evaluation can be used to find strategies robust to uncertainty in recruitment.

Under some circumstances, regime-based rules can reduce bias in target biomasses, but variance increases.

Regime-based rules are only appropriate for ranges of spawning biomass in which there is no apparent stock recruit relationship.

Observing recruitment many years before it is exploitable (e.g. through surveys) is a large advantage.