

Using ecosystem modeling for fisheries management and marine ecosystem conservation: Where are we?



The key questions

- Is ecosystem modeling an active research field?
- Are the models (potentially) useful for fisheries management?
 - This is closely linked to their use for conservation
- Are ecosystem models actually being used for fisheries management?

Ecosystem models for fisheries management

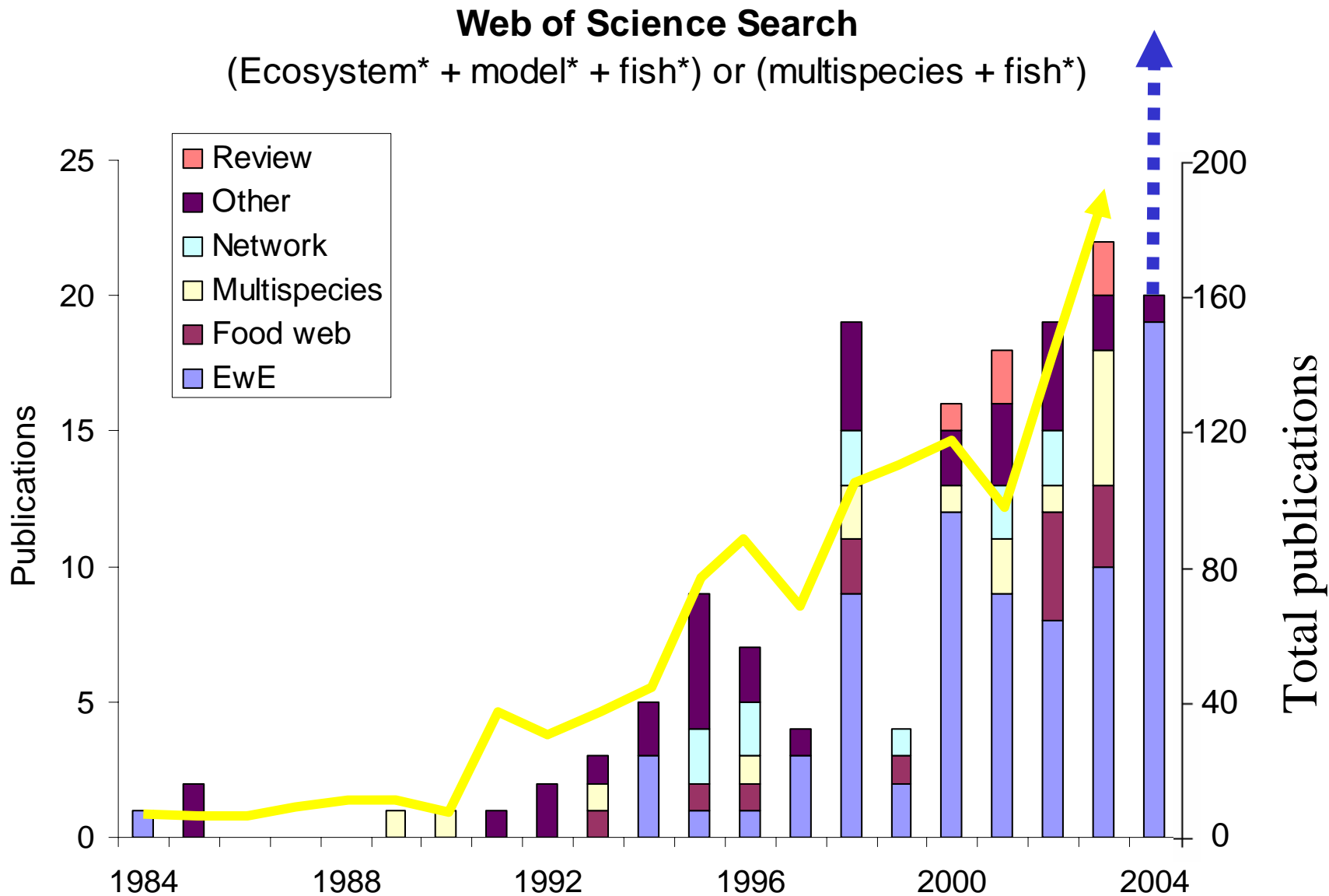
Criteria: must include trophic interactions and multiple trophic levels.

Examples of models considered here:

- Andersen and Ursin's North Sea
- MSVPA
- MULTSPEC
- BORMICON
- Gadget
- ERSEM
- Laevastu's Dynumes
- Network/food web
- Ecopath with Ecosim
- Fulton's Atlantis
- ...



Ecosystem model publications





EWE project activities

and there are also activities on the other side

The key questions

- Is ecosystem modeling an active research field?
- Are the models (potentially) useful for fisheries management?
 - This is closely linked to their use for conservation
- Are ecosystem models actually being used for fisheries management?

Are we finally able to develop useful predictive models for ecosystem management?

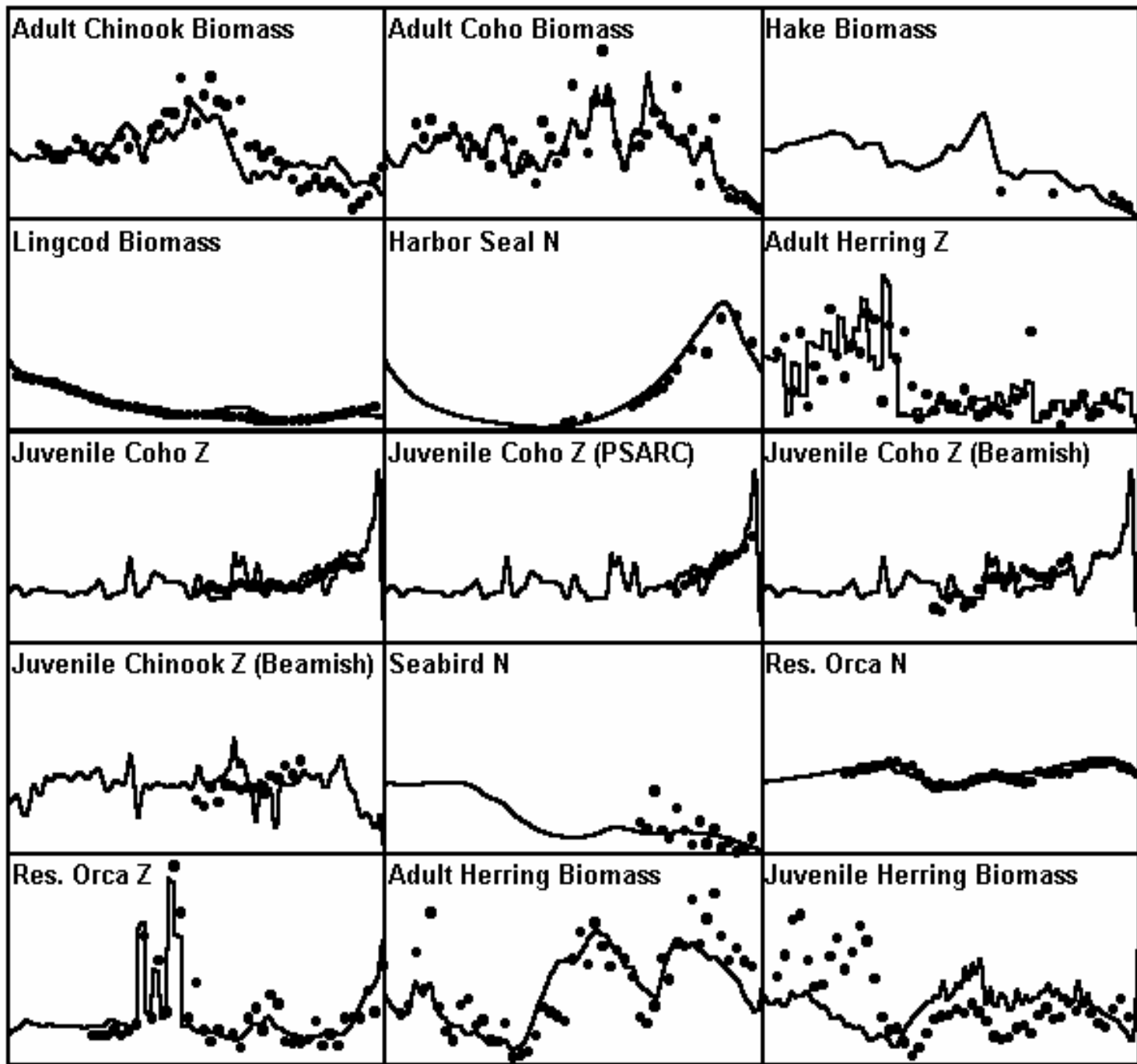
- It's beginning to look like it;
- We can with some credibility describe agents of mortality and trophic interdependencies;
- Focus on testing models against time series data.



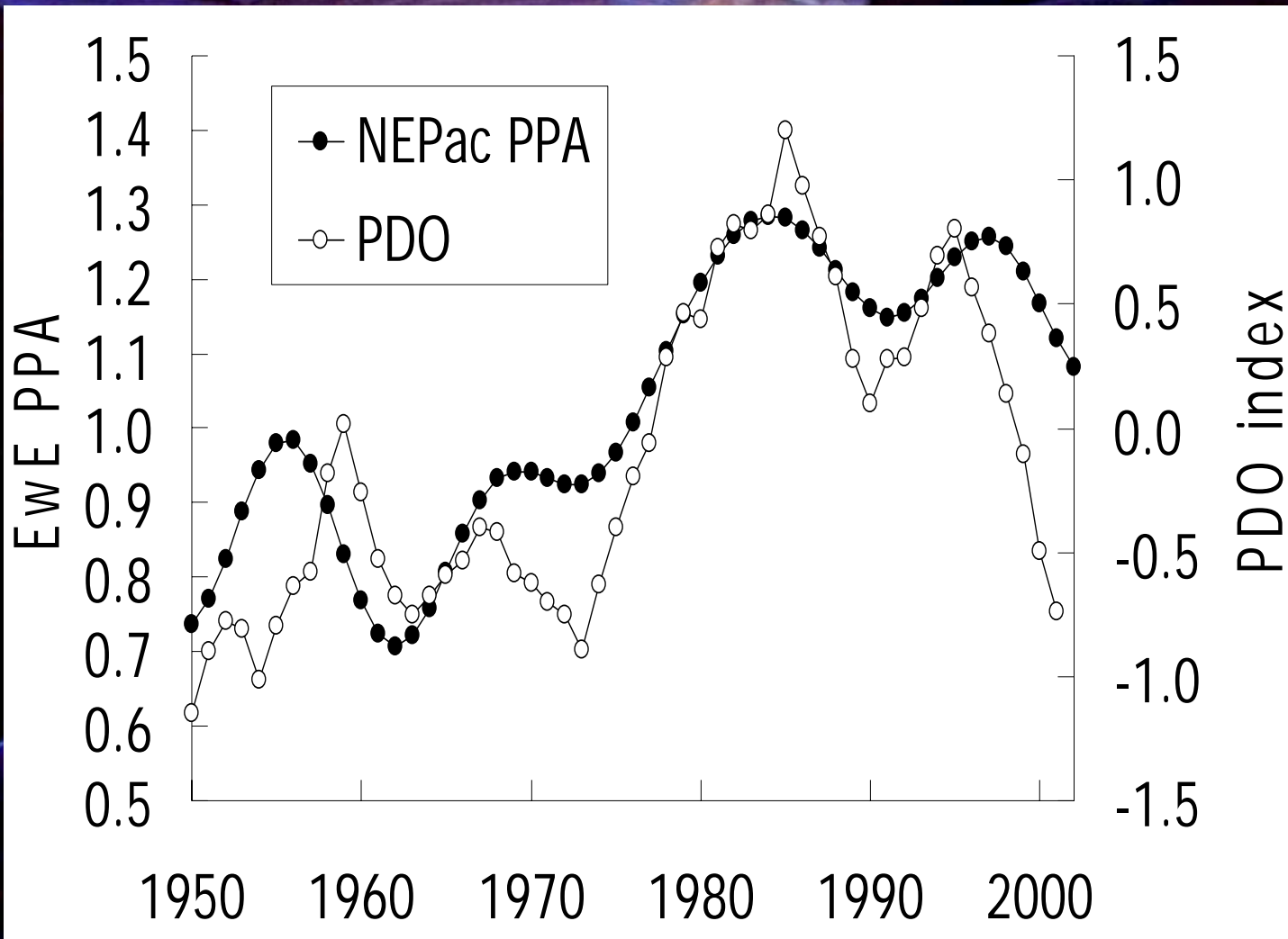
Ecosystems where EwE has been tested using historical trend data

- E Bering Sea
- Aleutian Islands
- W&C GoAlaska
- E GoAlaska
- W Vancouver Island
- Strait of Georgia
- NE Pacific
- Central N Pacific
- FF Shoals, Hawaii
- Central Chile
- Bay of Quinte
- Oneida Lake
- Scotian Shelf
- Chesapeake Bay
- Tampa Bay
- S Brazil Bight
- North Sea
- Baltic
- S Benguela
- Gulf of Thailand

**Strait of
Georgia
time series
from
assessments
or surveys
(dots)
compared to
Ecosim
(line)**



Models need to consider fisheries and environmental effects to explain history



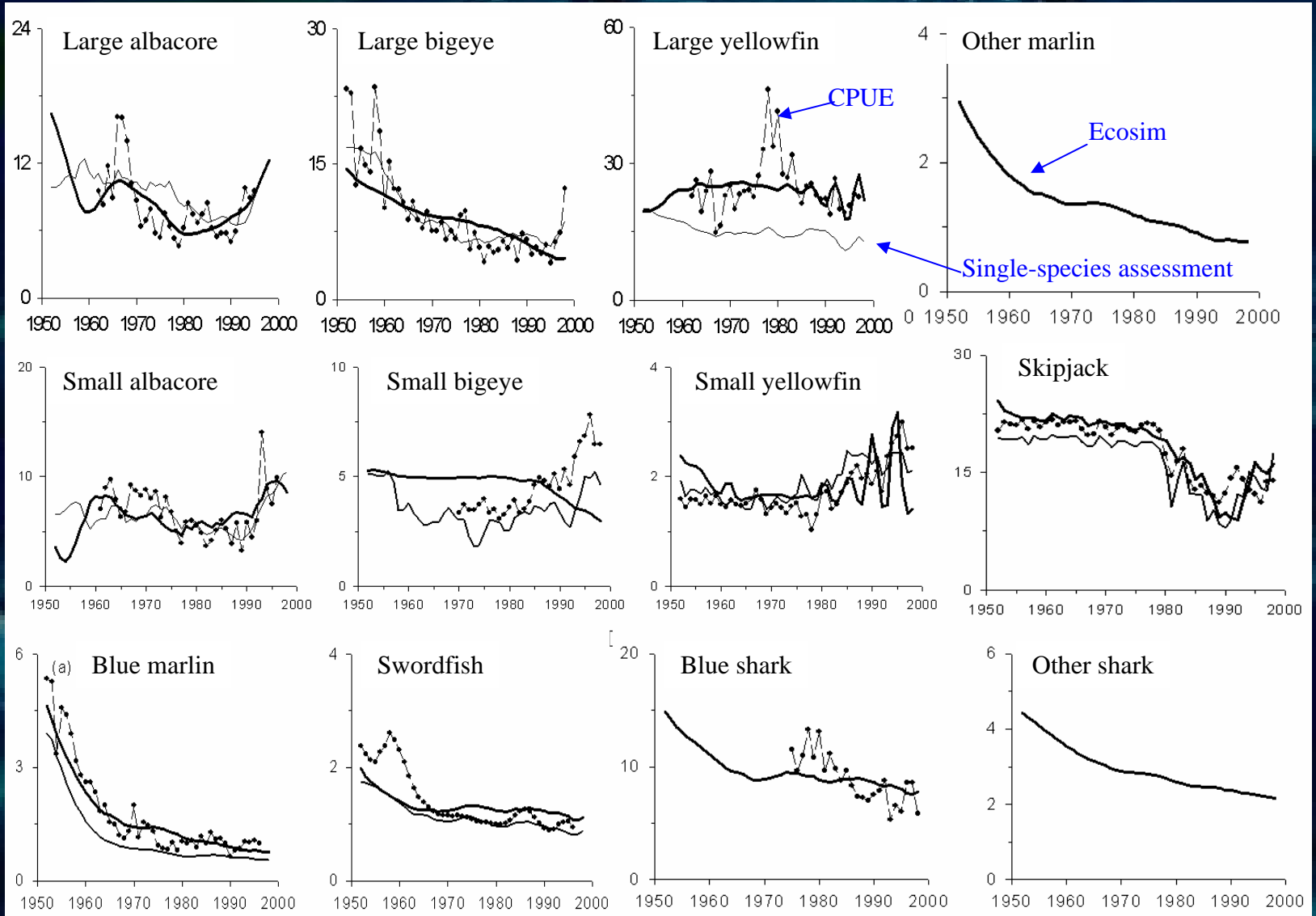
Primary
Production
Anomaly
predicted
by EwE

&

Pacific
Decadal
Oscillation
index

Central Pacific Ocean 1952-1998

Biomass ($\text{kg} \cdot \text{km}^{-2}$)



Experience so far:

- Prim. productivity anomalies are amplified rather than dampened up the food web;
- Possible to replicate development over time (tune to biomass data);
- Requires more data – but mainly data we should have at hand in any case: ‘the ecosystem history’;
- Supplements single species assessment, does not replace it;



Status

- Recent success in replicating the history of populations in a number of ecosystems based on fisheries and environmental impact;
- Reconciling fisheries with climate in the process;
- Research questions are starting to focus on management questions.

Use of EM for research: 4WFC

- Based on abstracts:
 - 54 contributions use ecosystem modeling
 - 42 of these use EwE
- Topics in 4WFC contributions:
 - Ecological questions 11
 - Historical reconstructions 16
 - Time series analysis 5
 - Policy exploration 20
 - Climate & fisheries 5
 - Spatial modeling: 6
 - Fisheries management 2

The key questions

- Is ecosystem modeling an active research field?
- Are the models (potentially) useful for fisheries management?
 - This is closely linked to their use for conservation
- Are ecosystem models (EM) actually being used for fisheries management?



Use of EM for fisheries management

- **Multispecies models**

- Estimating predation mortality for stock assessment;
- Limit harvest of prey species to meet consumer demands;
- Impact of changing mesh size, North Sea roundfish;
- Minke whale and harp seal management?
- Environmental Impact Assessment, Alaska groundfish;
- Target species response to TACs, Bering Sea.

Use of EM for fisheries management

- EwE

- Evaluate impact of shrimp trawling, GoCalifornia;
- Evaluate impact of bycatch, GoCalifornia;
- Evaluate impact of predators on shrimp, GoMexico;
- Demonstrate ecological role of species, GoMexico;
- Impact of proposed fisheries interventions, Namibia?
- EIA of proposed fisheries interventions, Bering Sea;
- EIA of alternative TAC's, Bering Sea and GoAlaska.

So, not much actual use of ecosystem models as part of the fisheries management process (yet)



- Why?



So why aren't ecosystem models being used more for management?

- Lack of experience with use of ecosystem models for predictive purposes;
- Ecosystem modeling is for strategic management, and supplements the tactical single species assessment;
- Fisheries management process is trapped in tactical management;
- Strategic decisions are non-existing;
- Calls for institutional change.

While we push for change

- Are we ready to use models for strategic decision making?
- What is the current situations?
 - Ecosystem manipulation is common, but based on a less optimal set of decision tools (often accidentally)
 - Calls for modeling to guide adaptive management experiments;
- It's time to implement strategic considerations as part of the management process.

Acknowledgments:

- Hugo Arancibia
- Francisco Arreguín-Sánchez
- Poul Degnbol
- Are Dommasness
- Marten Koops
- Patrick Lehodey
- Pat Livingston
- Jean-Jacques Maguire
- Charles K. Minns
- Daniel Pauly
- Torstein Petersen
- Kim Stobberup
- Carl Walters

