Ecological Risk Assessment (ERA) for bycatch monitoring and assessment in an RFMO context

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Under its founding Convention, WCPFC must conserve and manage all UNCLOS Annex 1 'Highly Migratory Fish Species' (HMFS) plus non-target 'associated and dependent' species (NTADs): there are 58 HMFS, inc. 30 shark species, and >200 NTADs observed caught in WCPO tuna fisheries

Lodge et al. (2007) call for:

"risk-based impact assessment of the effect of fishing activities on non-target species, followed by explicit analytical assessments and/or action when risk is determined to be high"

RECOMMENDED BEST PRACTICES FOR REGIONAL FISHERIES MANAGEMENT ORGANIZATIONS

Lodge MW, Anderson D, Løbach T, Munro G, Sainsbury K, Willock A (2007)

Royal Institute of International Affairs, Chatham House, London, UK

Two 'schools' of Ecological Risk Assessment for fisheries management:

(1) ERA as a hierarchy of methods of increasing sophistication, data requirement & cost

Level 1: Stakeholder workshops
Level 2: Multispecies methods
Level 3: Single species methods

Management action can follow analysis at any level, including the decision to proceed to the next level of analysis

(2) ERA as a fisheries management planning exercise, engaging stakeholders, stating explicit management objectives, and evaluating the likelihood and consequence of not achieving them (e.g. FFA EAFM)

Main aspects of WCPFC Ecological Risk Assessment (ERA) project

ERA input – fisheries monitoring by scientific observers

- **Support national & regional observer programmes (e.g. training, species ID guides, data management)**

Data analysis – multi-species >> single-species

- **Catch estimation for non-target species using observer data and logbook data**
- **Multi-species analyses (e.g. PSAs) to identify apparent relative risk**
- **More detailed single-species analysis for those species at high risk**

ERA output – mitigation and management measures

- **Bycatch mitigation measures: document & disseminate technical information on best practice; carry out gear trials**
- **Evaluate effectiveness of WCPFC Conservation & Management Measures**
- **Develop/evaluate National/Regional Plans of Action for turtles, sharks, & seabirds**

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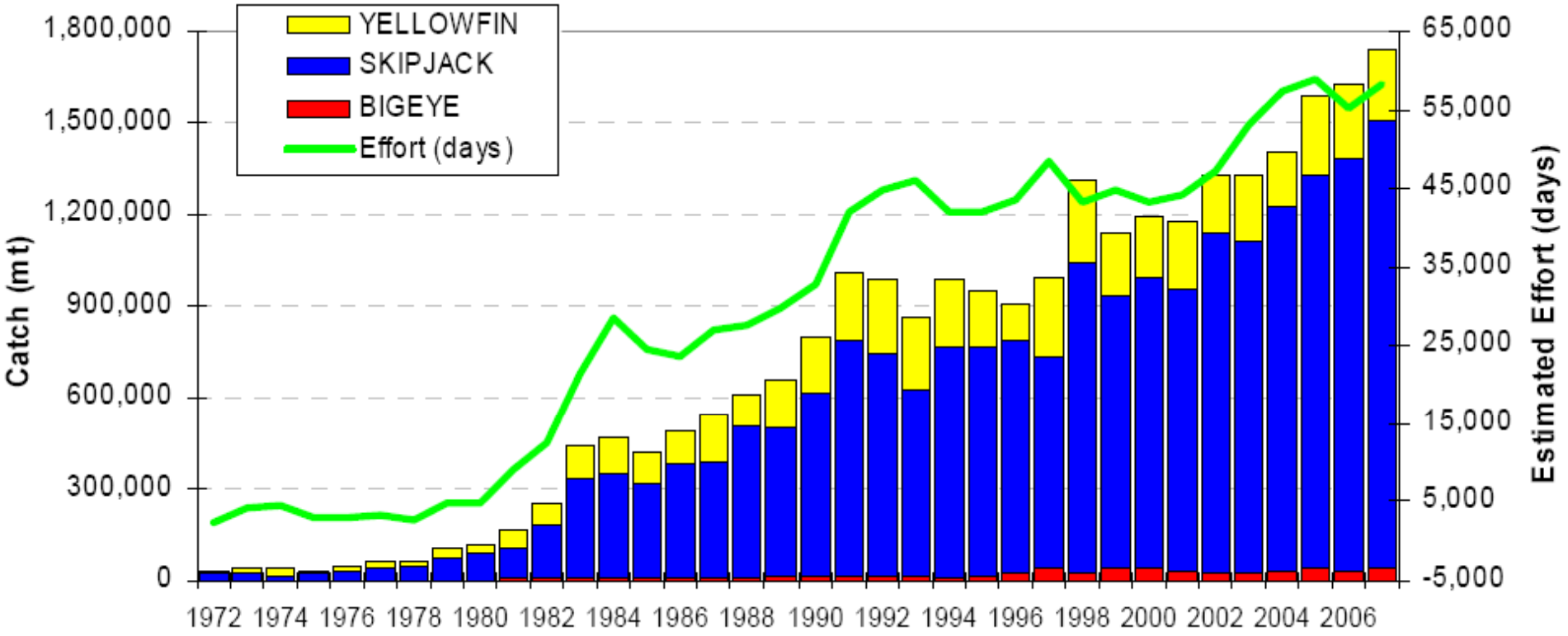
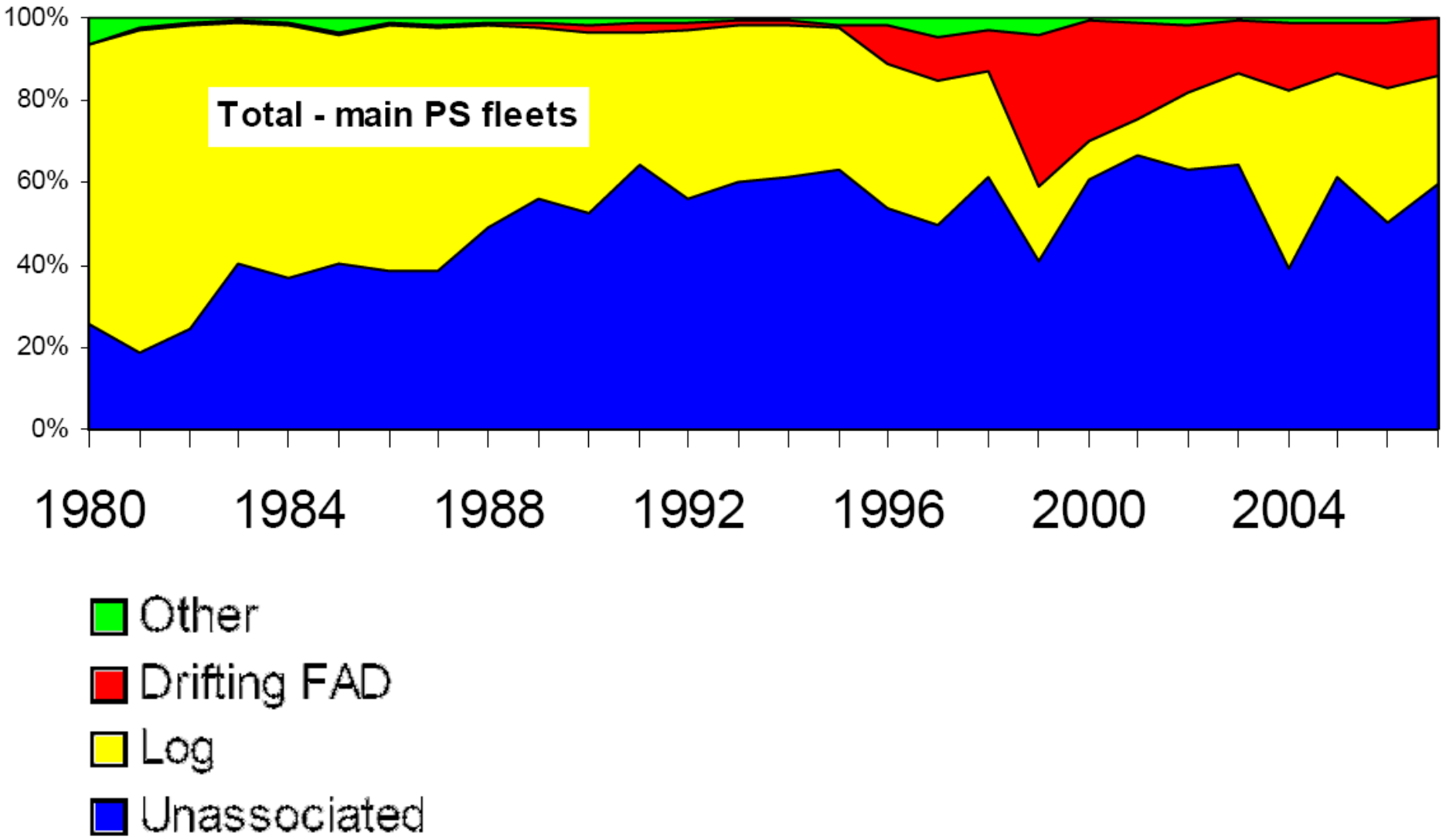
Ecological Risk Assessment for Purse Seine Fisheries

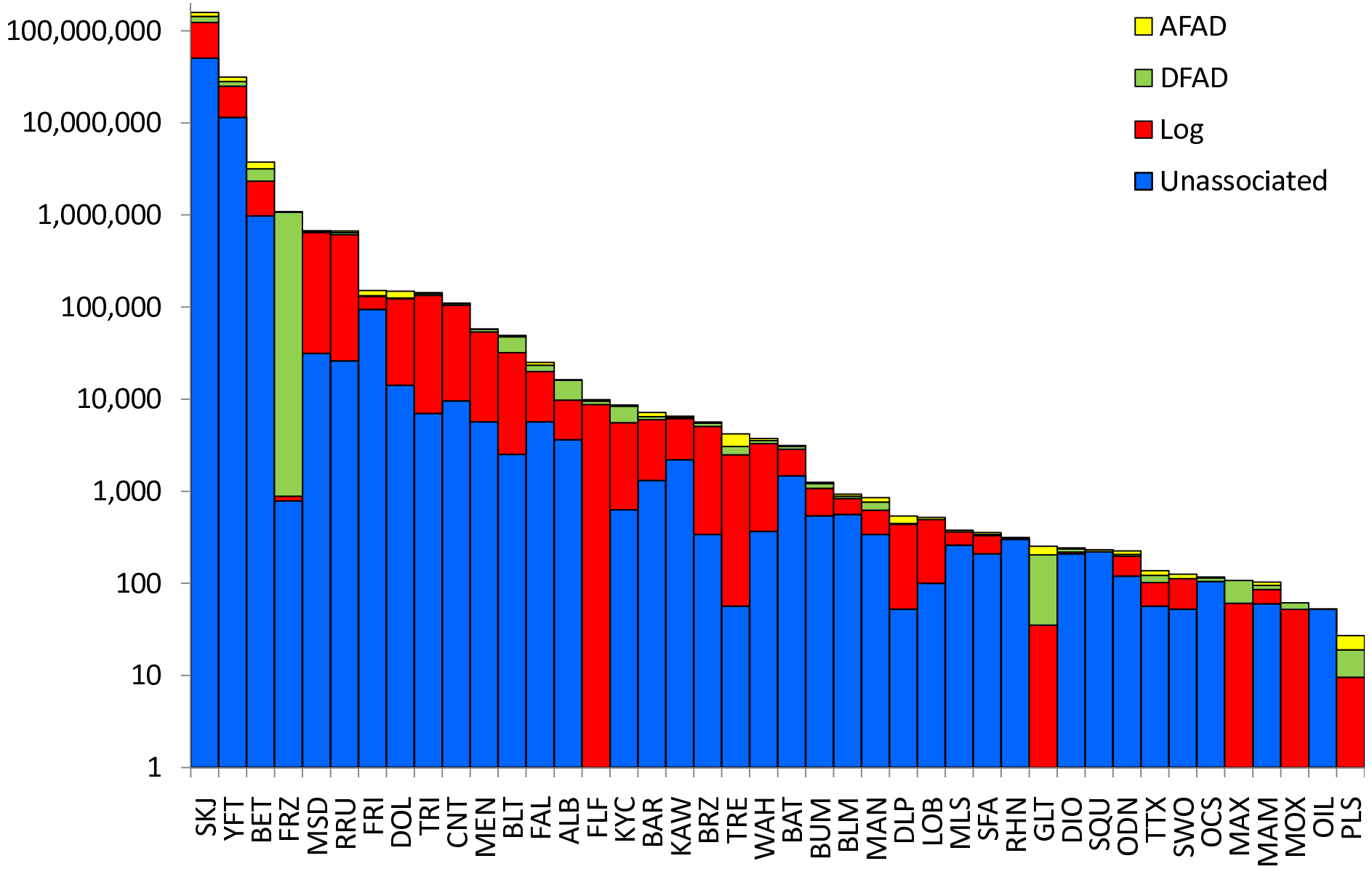
Development of WCPO purse seine fishery – catch of tunas



Development of WCPO purse seine fishery – effort by set type



Bycatch in purse seine fisheries – catch by species and set type



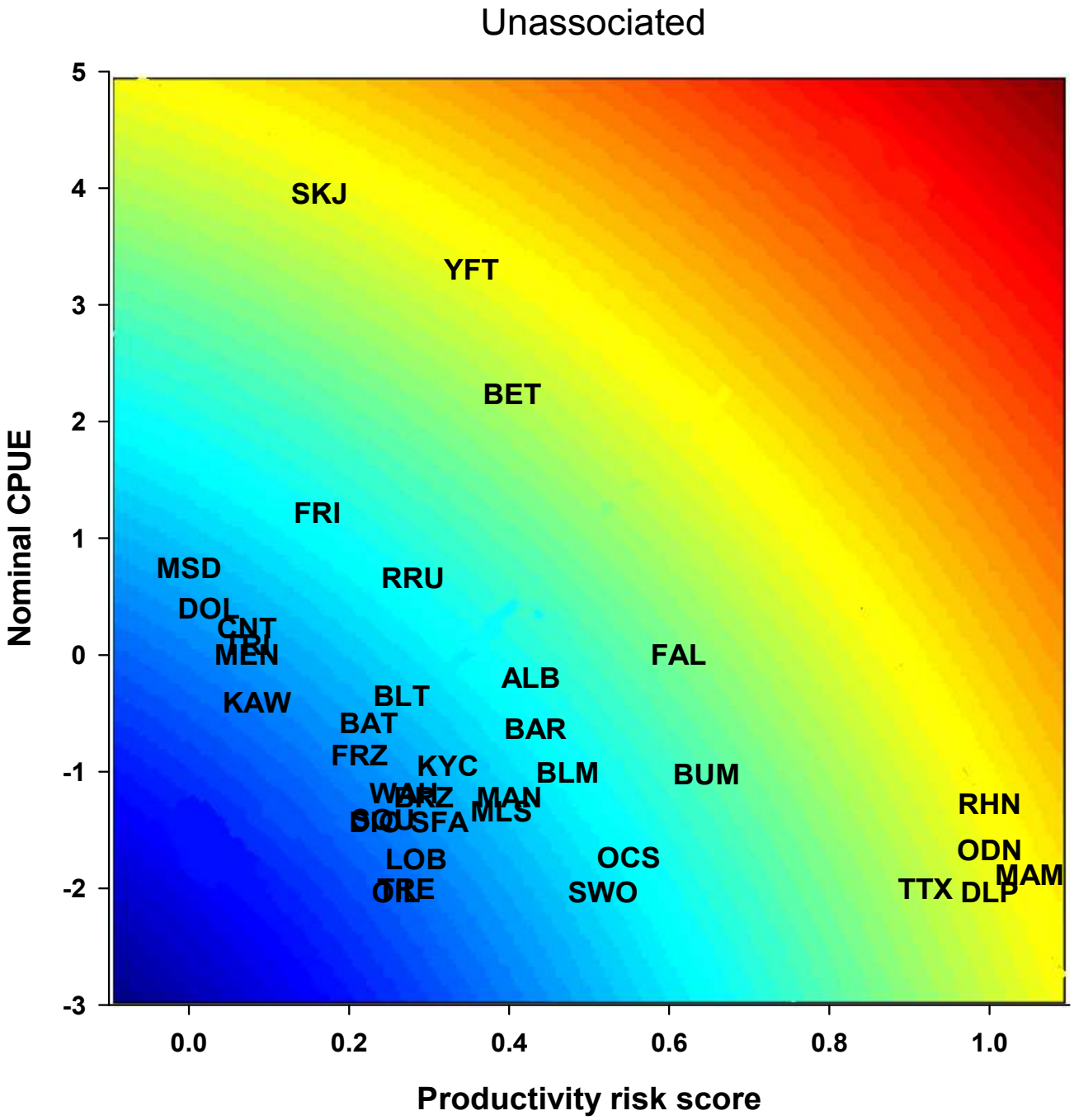
Productivity-Susceptibility Analyses for Purse Seine Fisheries

Indicators for Susceptibility (multiplicative)

- **Catch/CPUE**
- **Survival (condition, fate, post-release mortality)**
- **Spatial overlap between species and gear (vertical, horizontal)**

Indicators for Productivity (additive)

- **Lifespan**
- **Delayed maturity (Age-at-maturity / lifespan)**
- **Reproductive output (fecundity × frequency)**
- **Natural mortality**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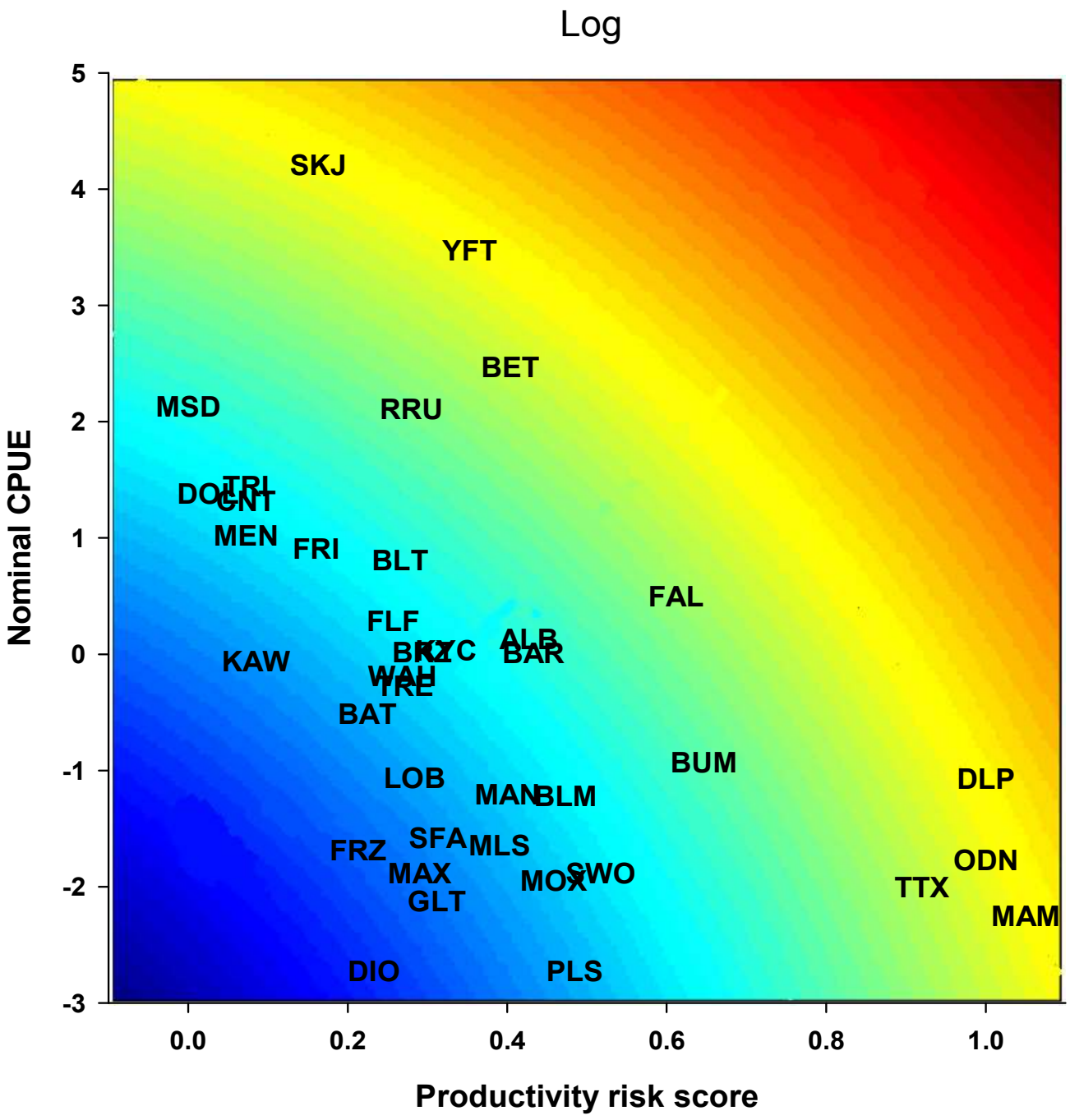
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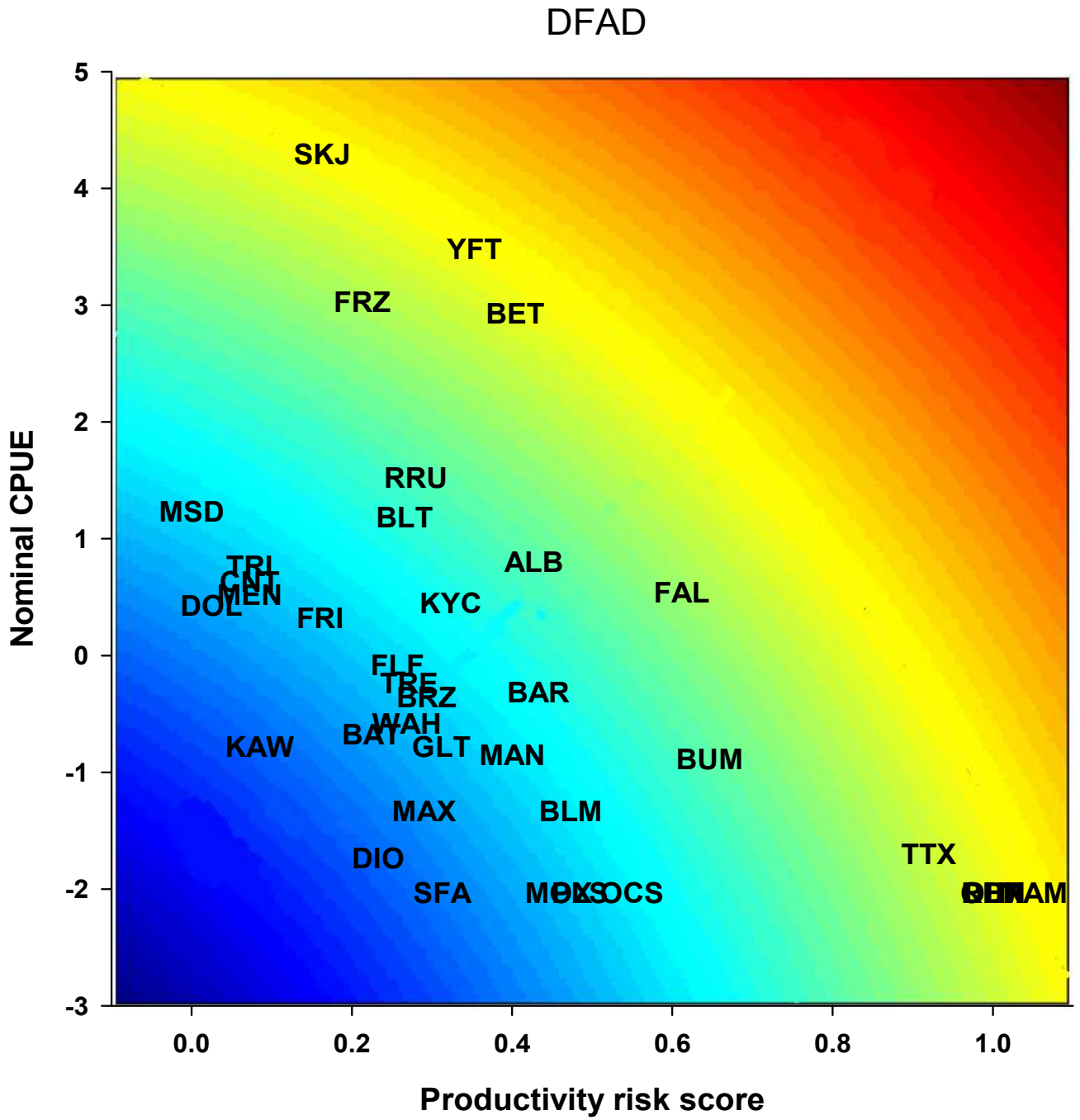
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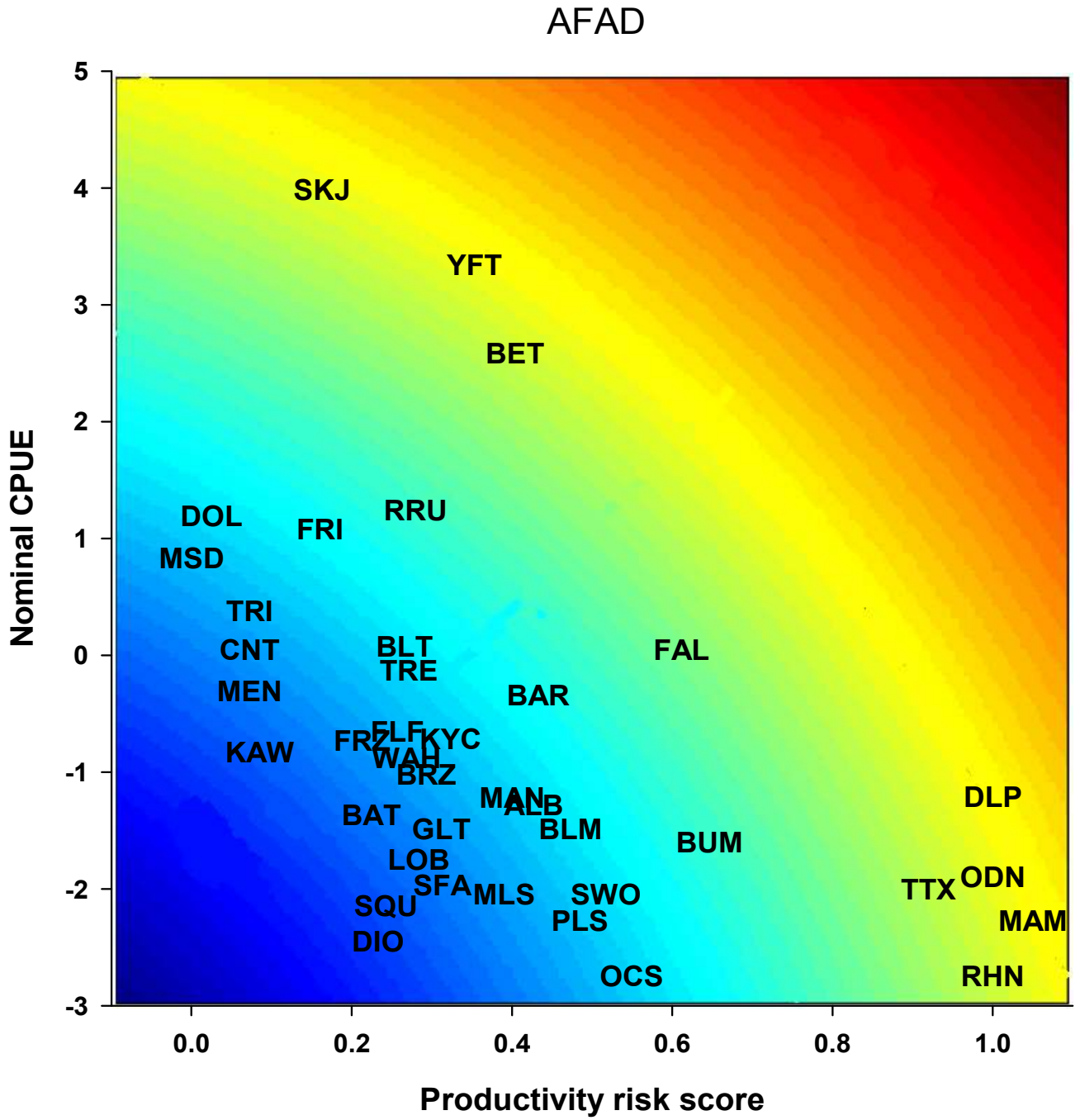
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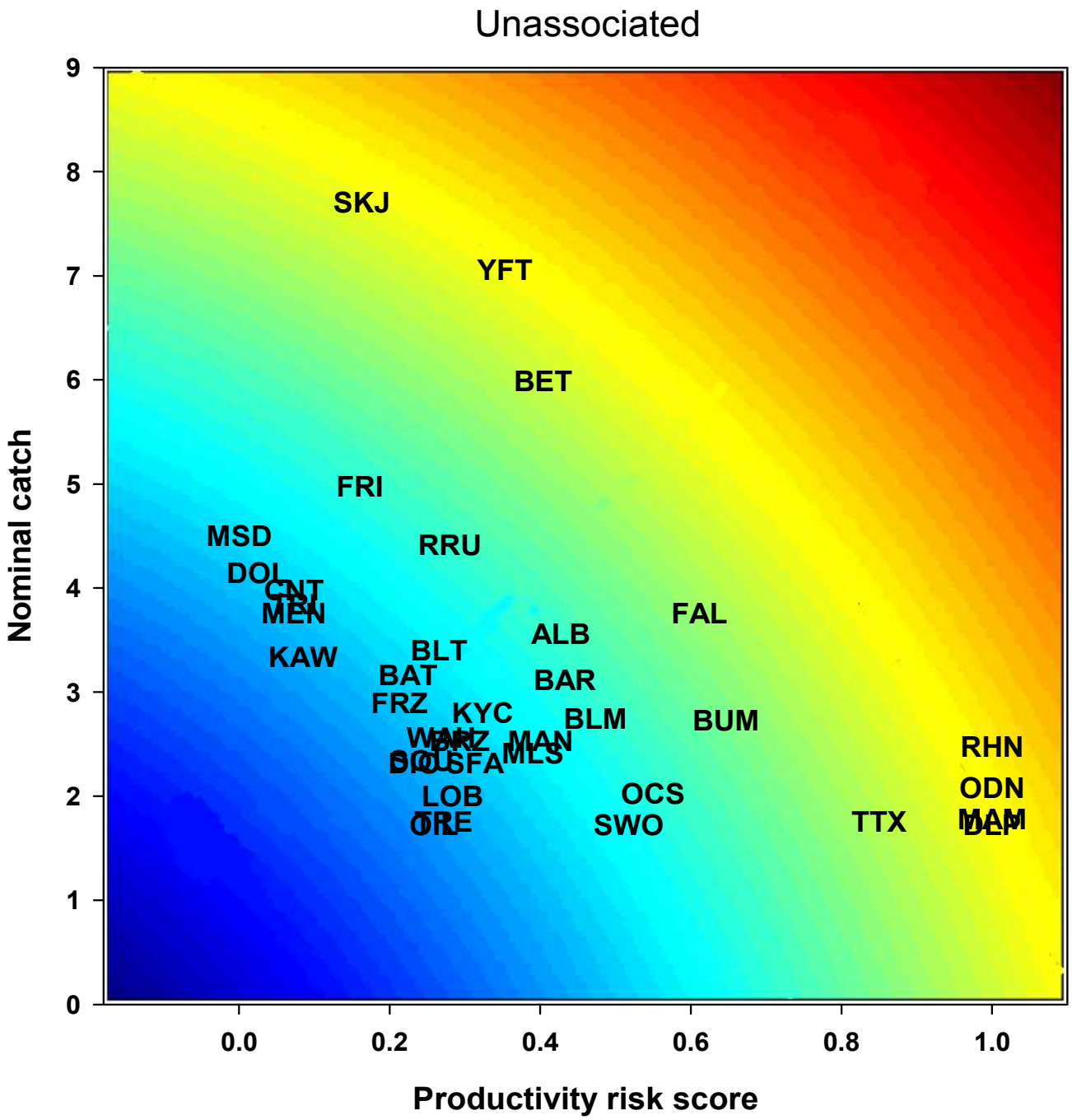
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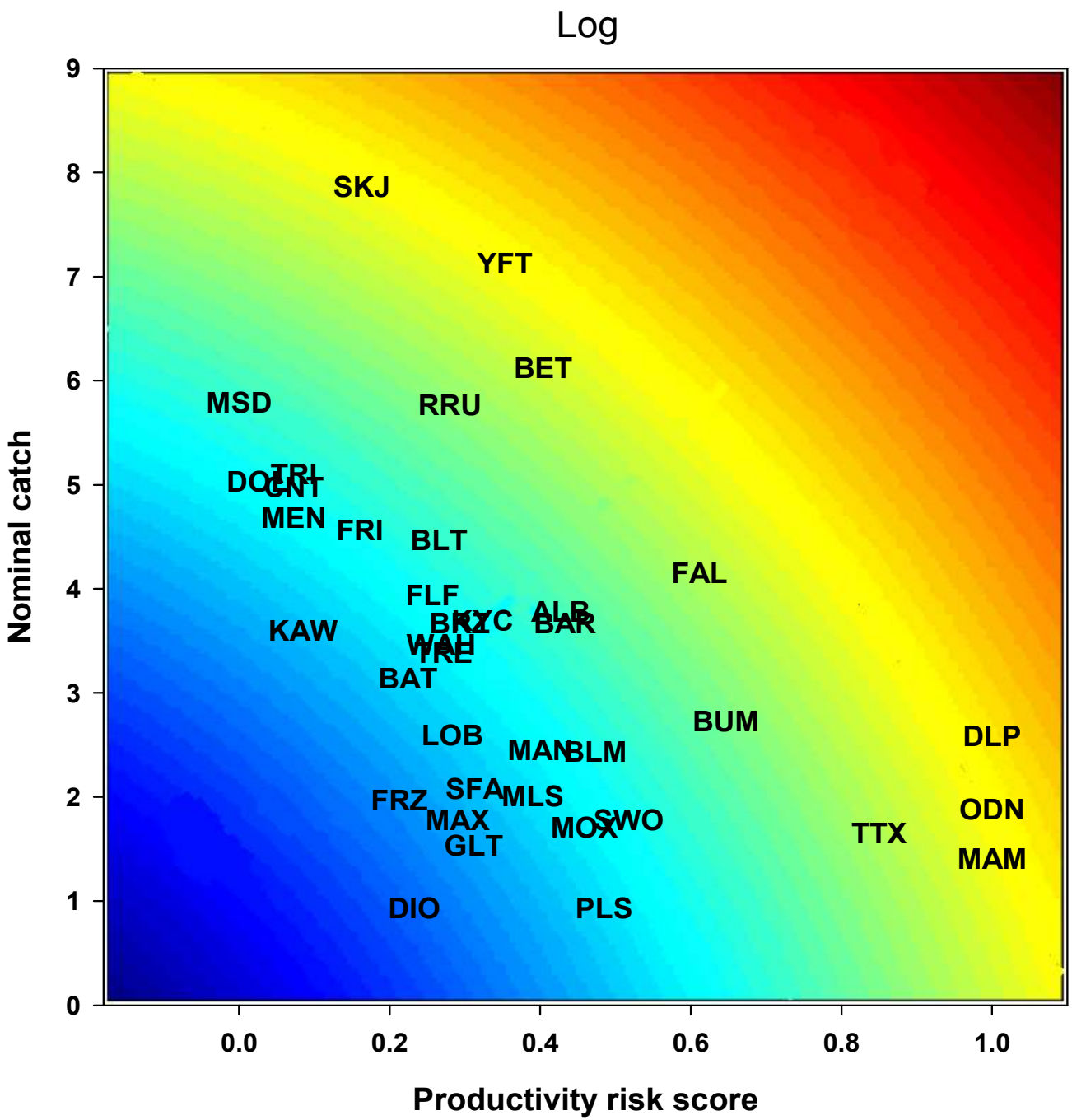
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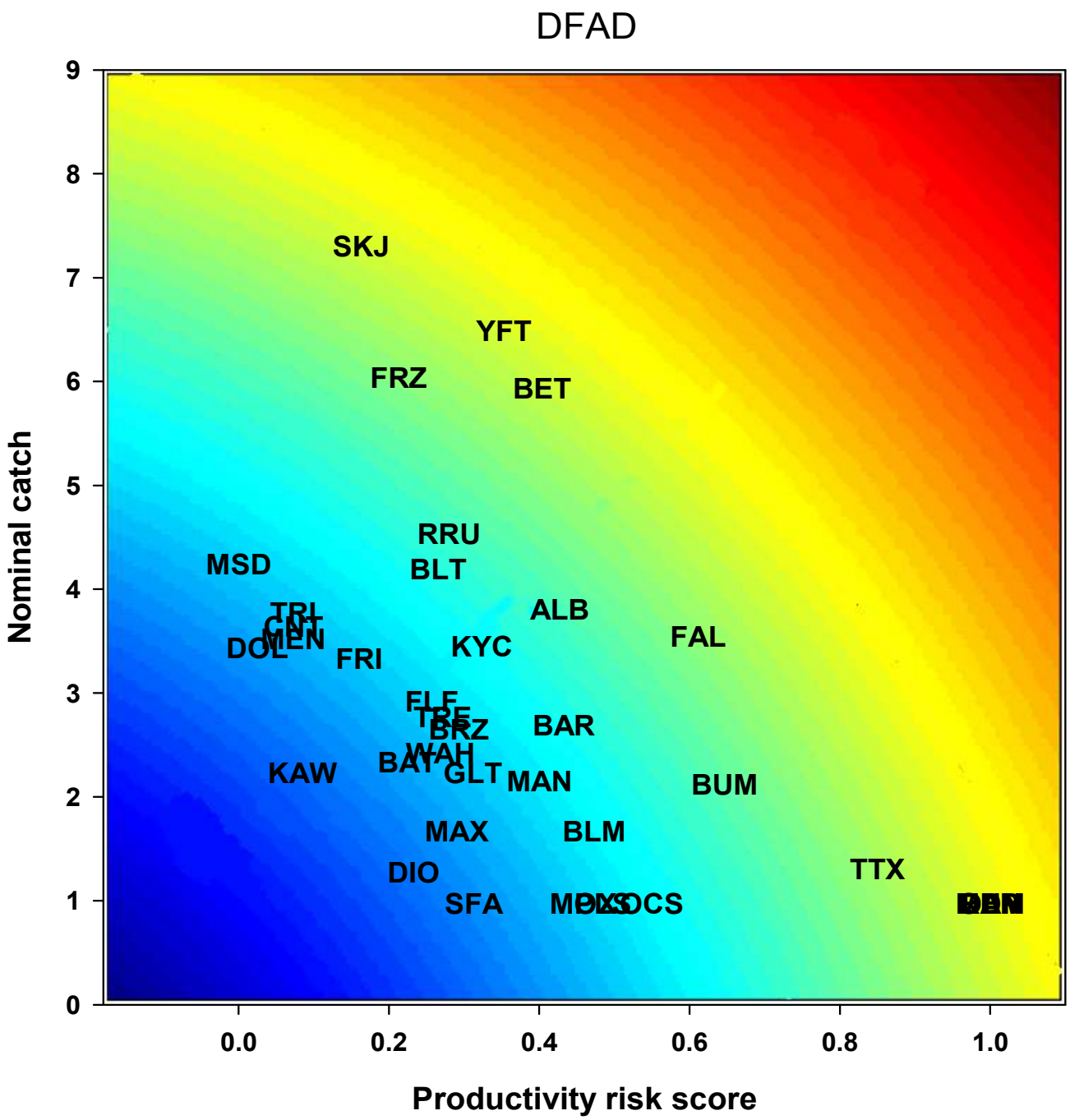
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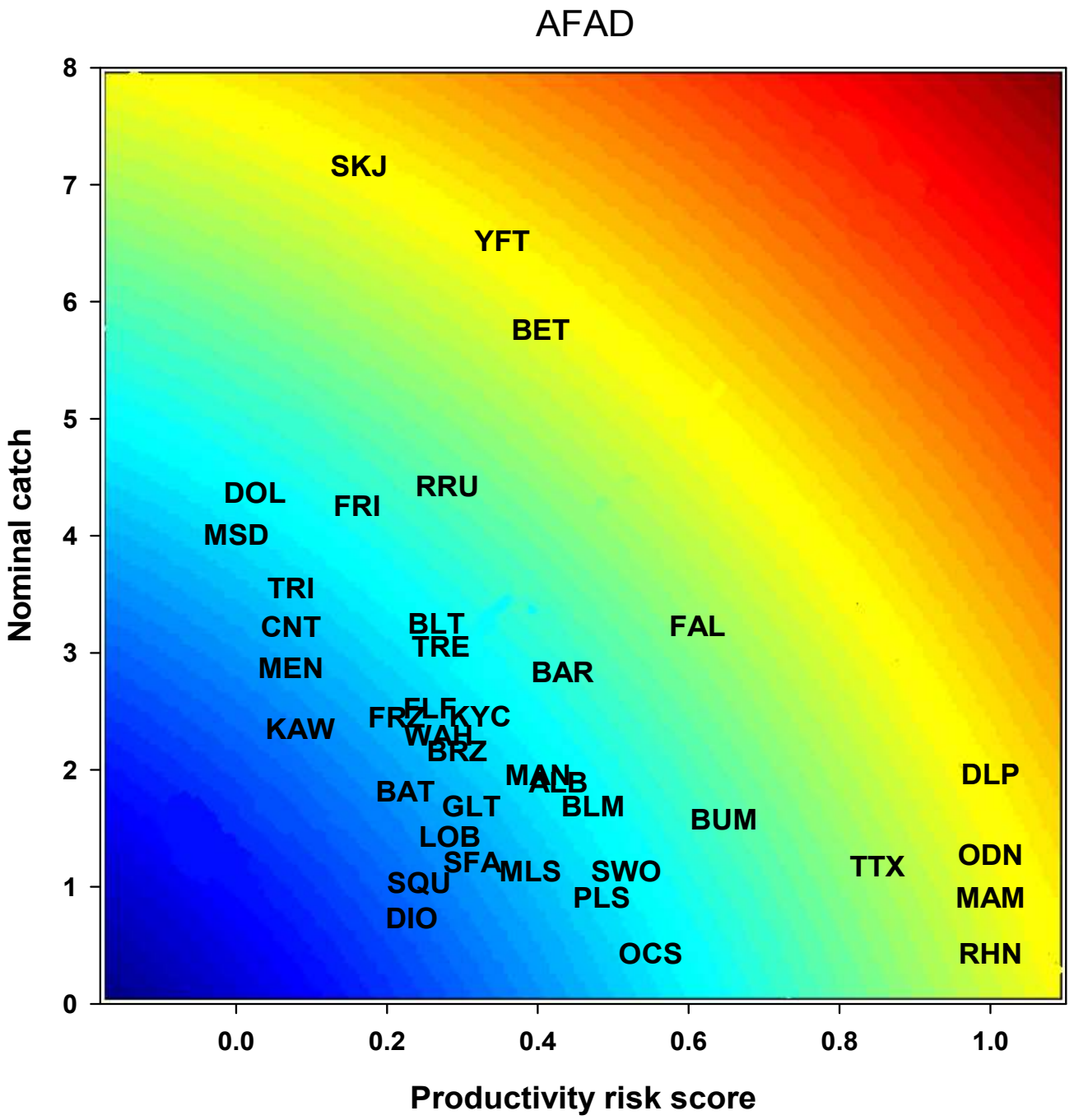
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Nominal catch
Productivity risk score
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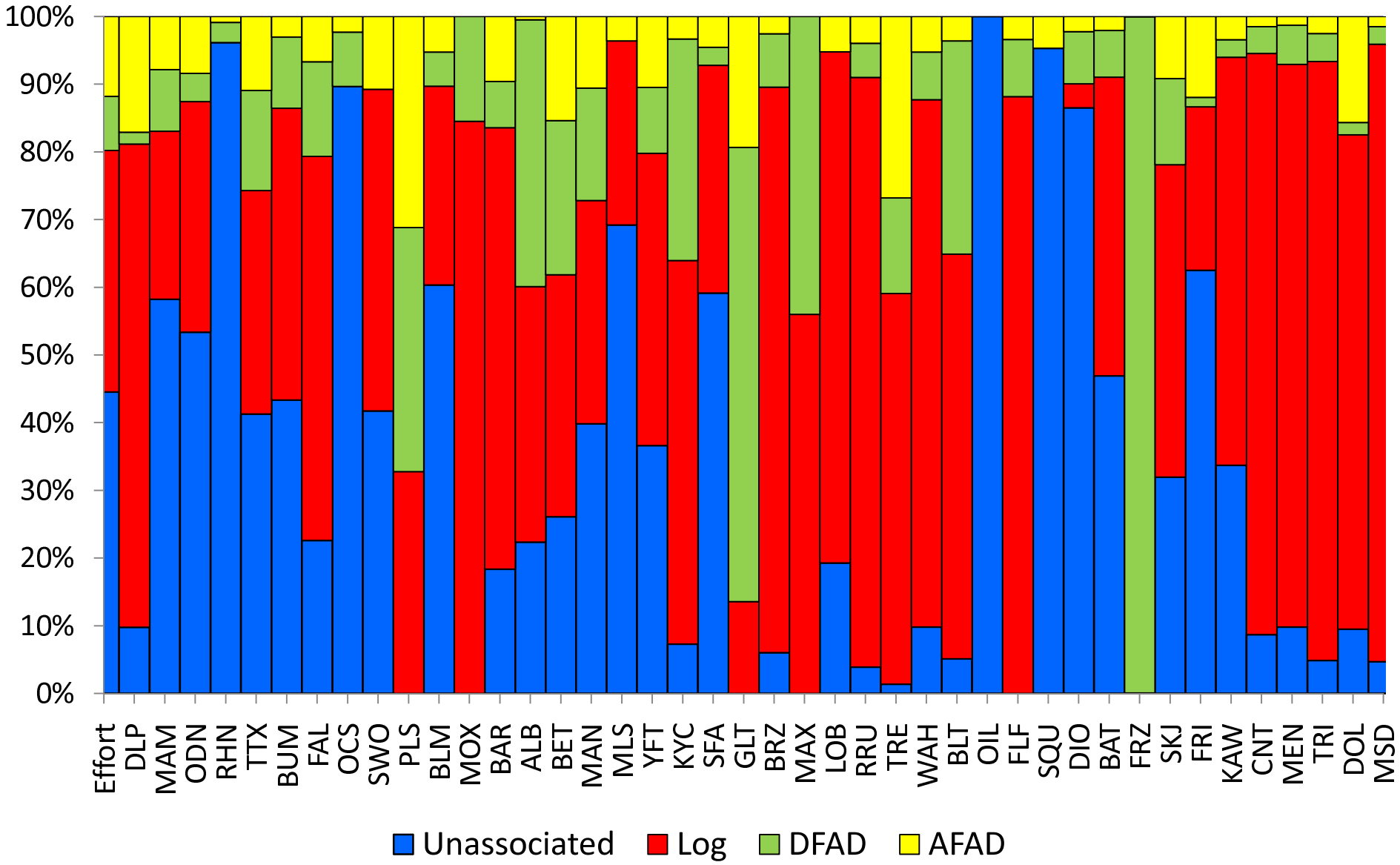
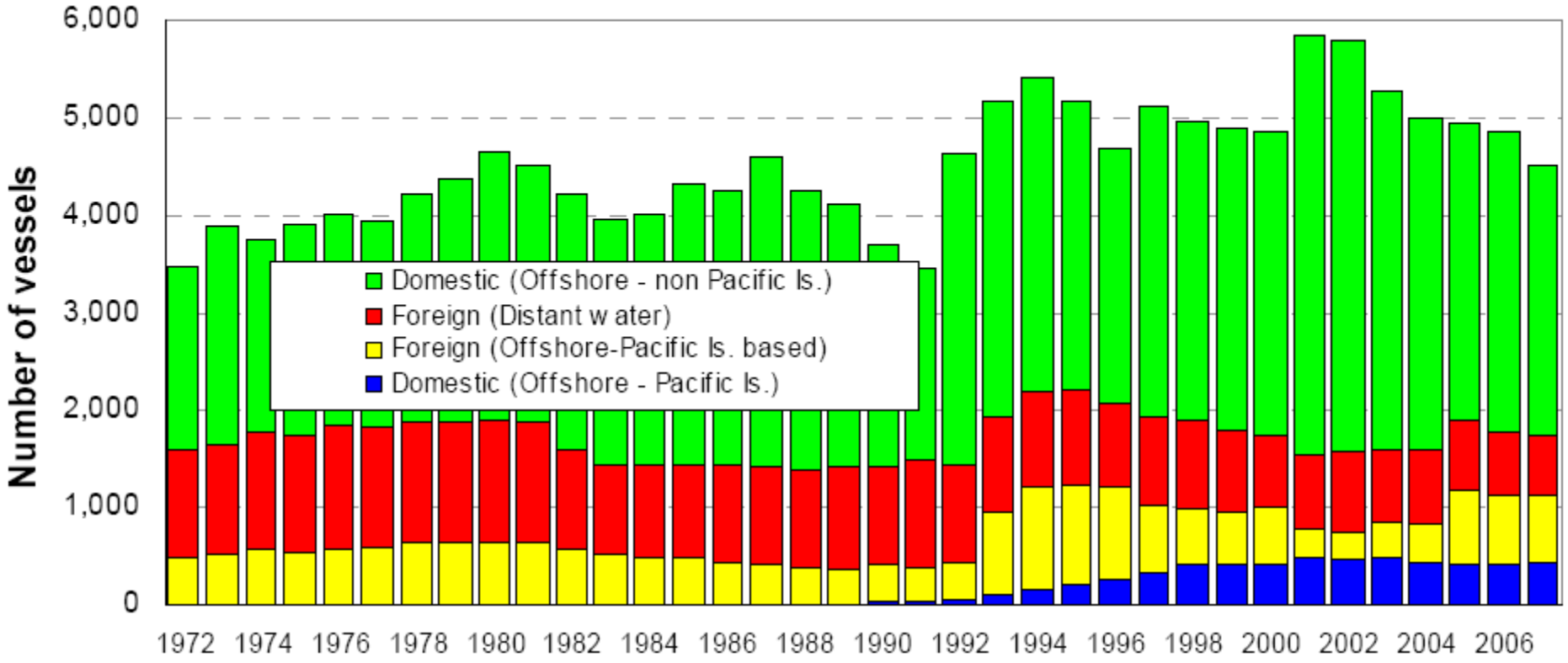
Attribution of fishing mortality by set type for each species, ranked by high (left) to low (right) productivity risk score

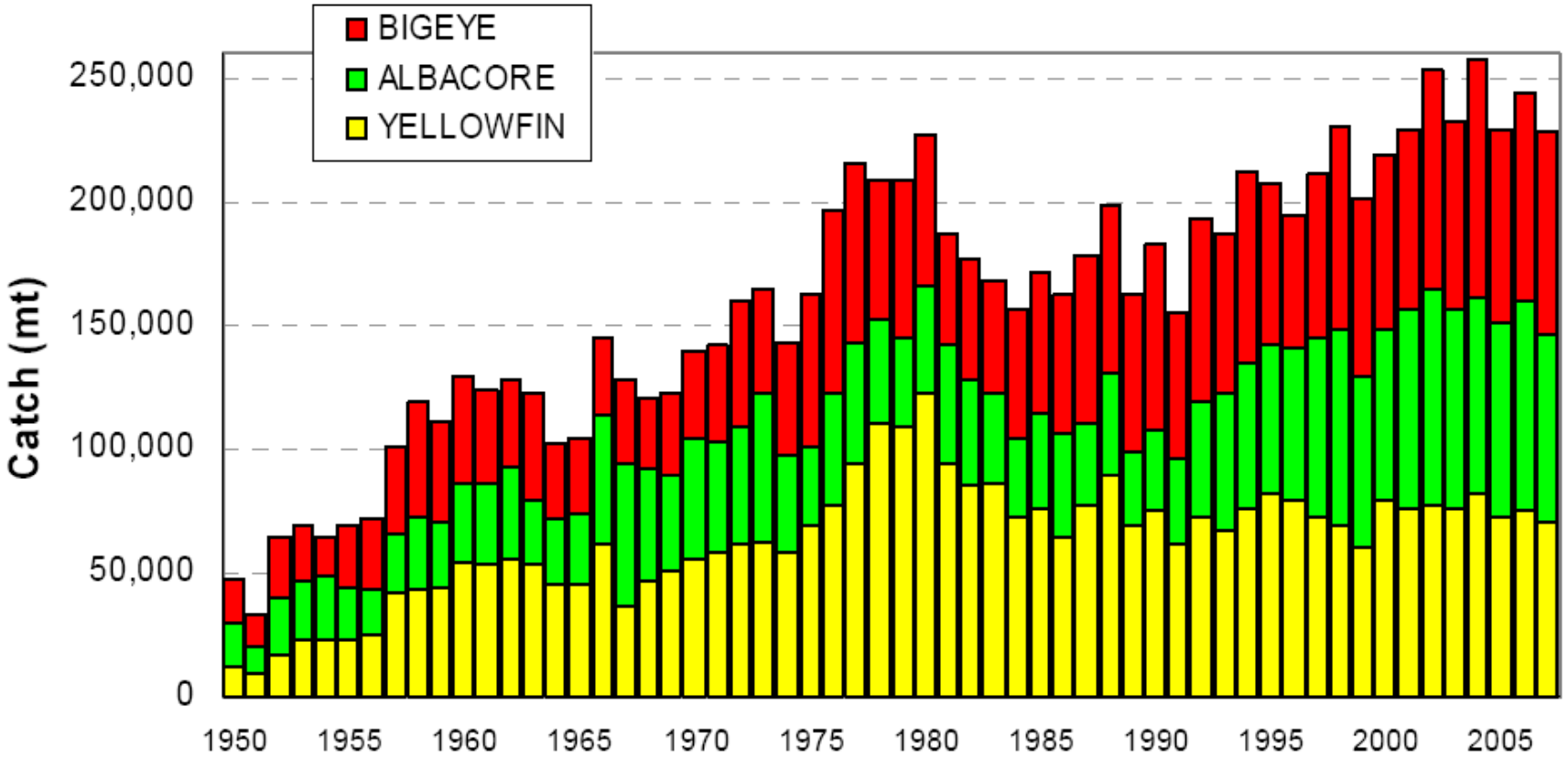


Ecological Risk Assessment for Longline Fisheries

Development of WCPO longline fishery – vessel numbers



Development of WCPO longline fishery – catch of tunas



Productivity-Susceptibility Analyses for Longline Fisheries

Indicators for Susceptibility (multiplicative)

- **Catch/CPUE**

…or…

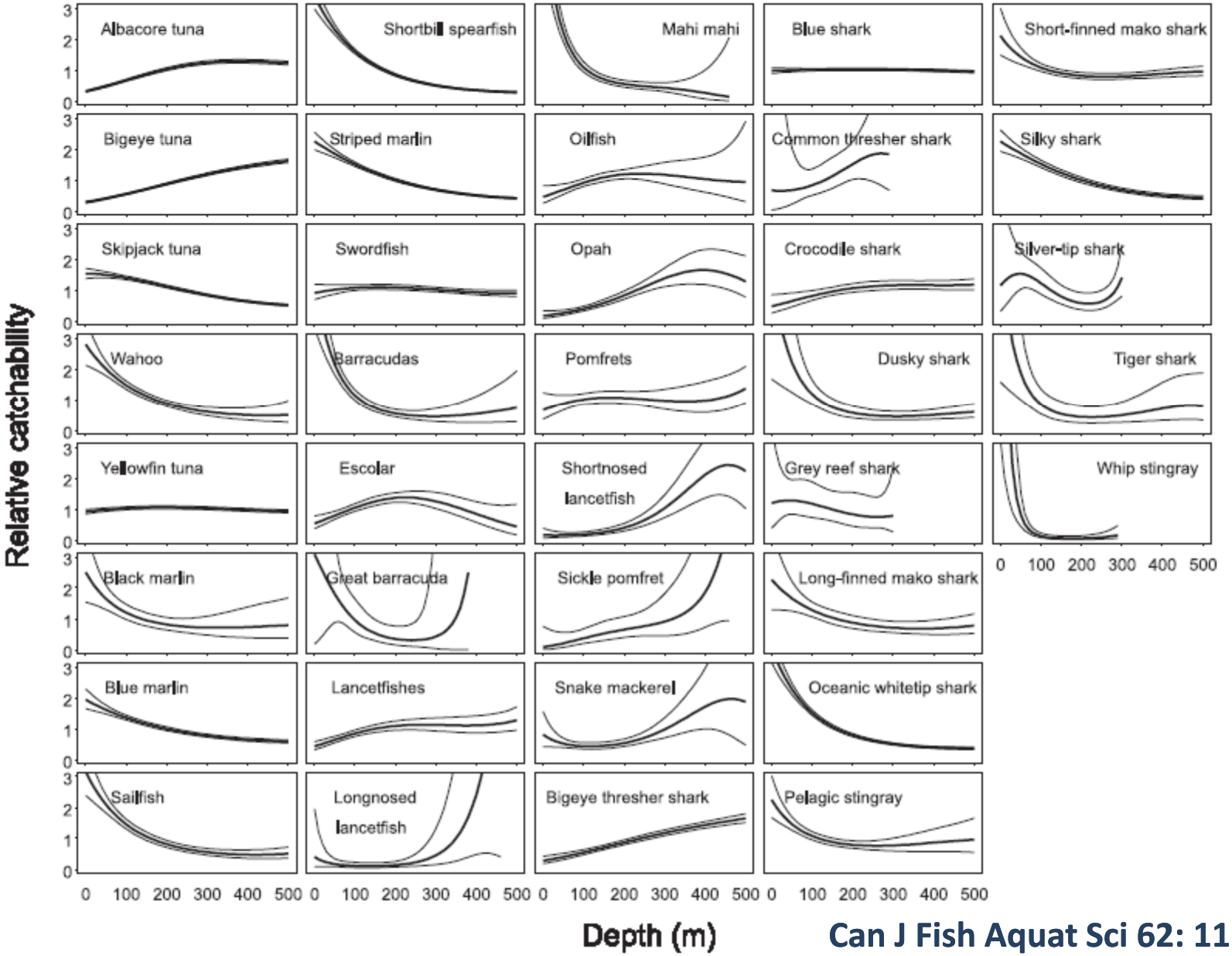
- **catchability × effort**
- **Survival (condition, fate, post-release mortality)**
- **Spatial overlap between species and gear (horizontal)**

Indicators for Productivity (additive)

- **Lifespan**
- **Delayed maturity (Age-at-maturity / lifespan)**
- **Reproductive output (fecundity × frequency)**
- **Natural mortality**

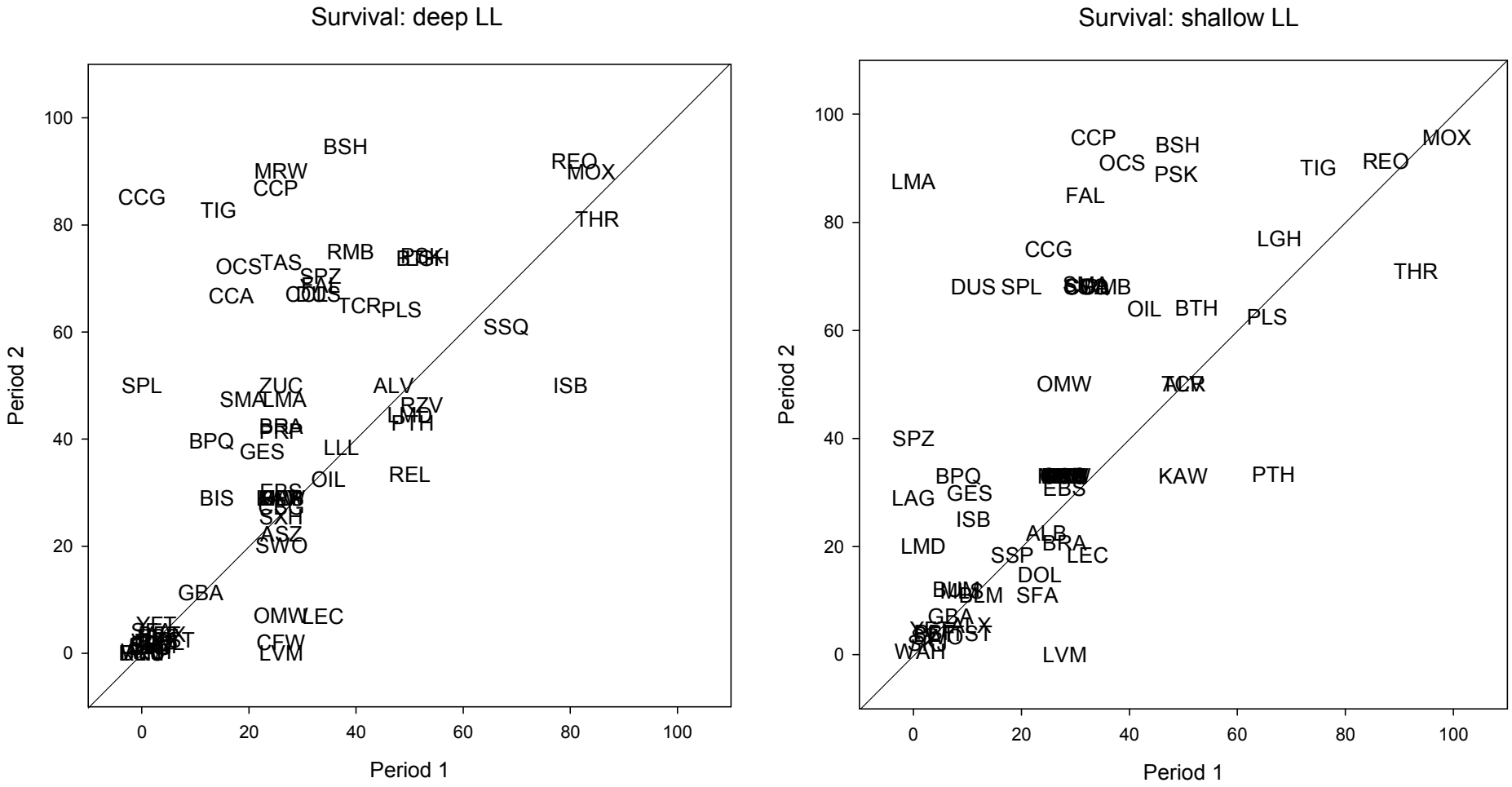
Ward & Myers 2005 'Inferring depth distribution of catchability…'

Fig. 3. Estimates of the depth distribution of catchability $f(D)$ (thick line) with the 95% prediction intervals (thin lines) for day long-lining operations. The mean catchability has been set to 1 to facilitate comparison between species and species groups.



Can J Fish Aquat Sci 62: 1130–1142

Survival (%) of sharks in Hawaii deep (left) & shallow (right) longline fisheries, before (*x*-axis) and after (*y*-axis) a shark finning ban



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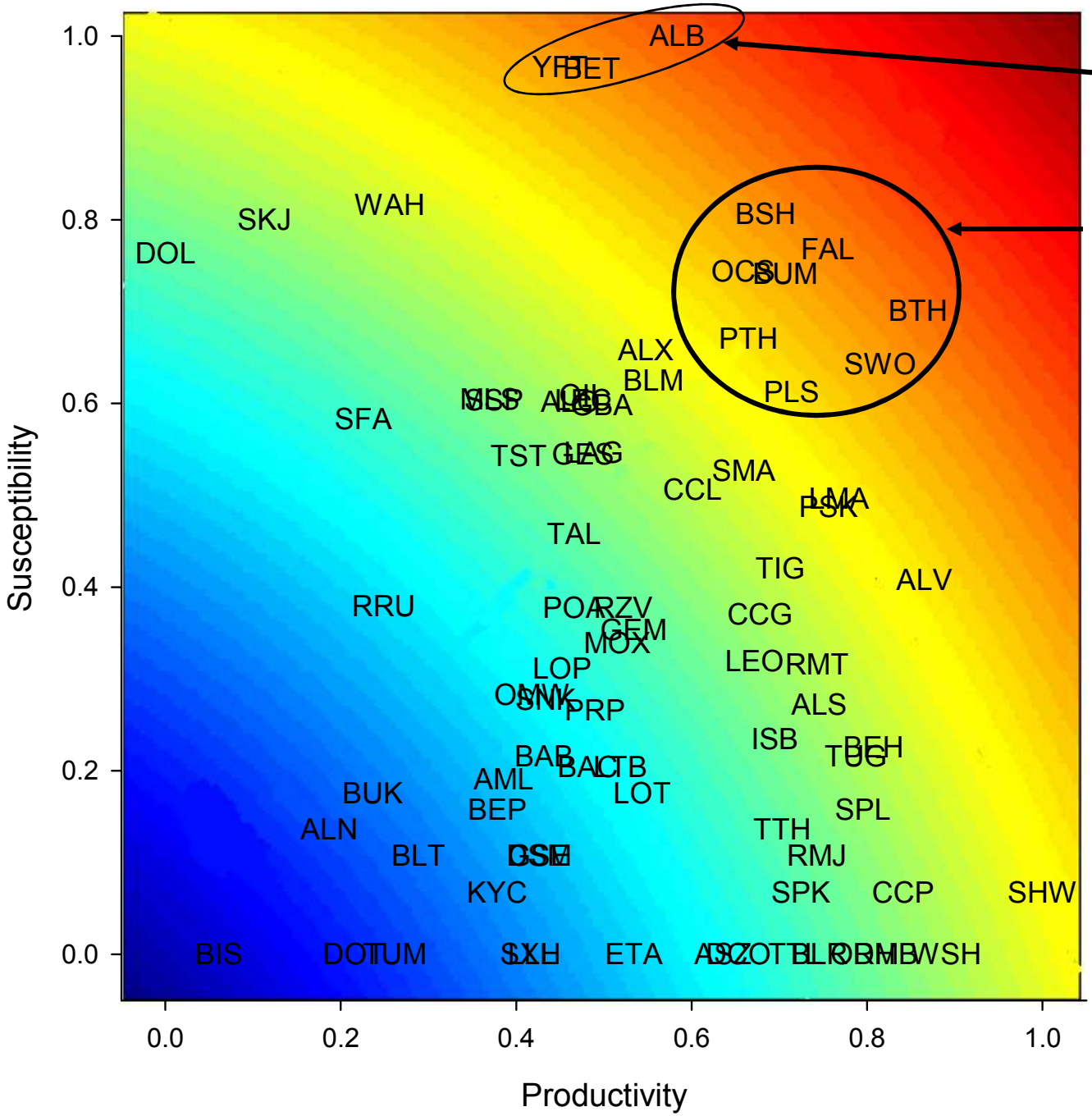


Tunas

SHARKS:

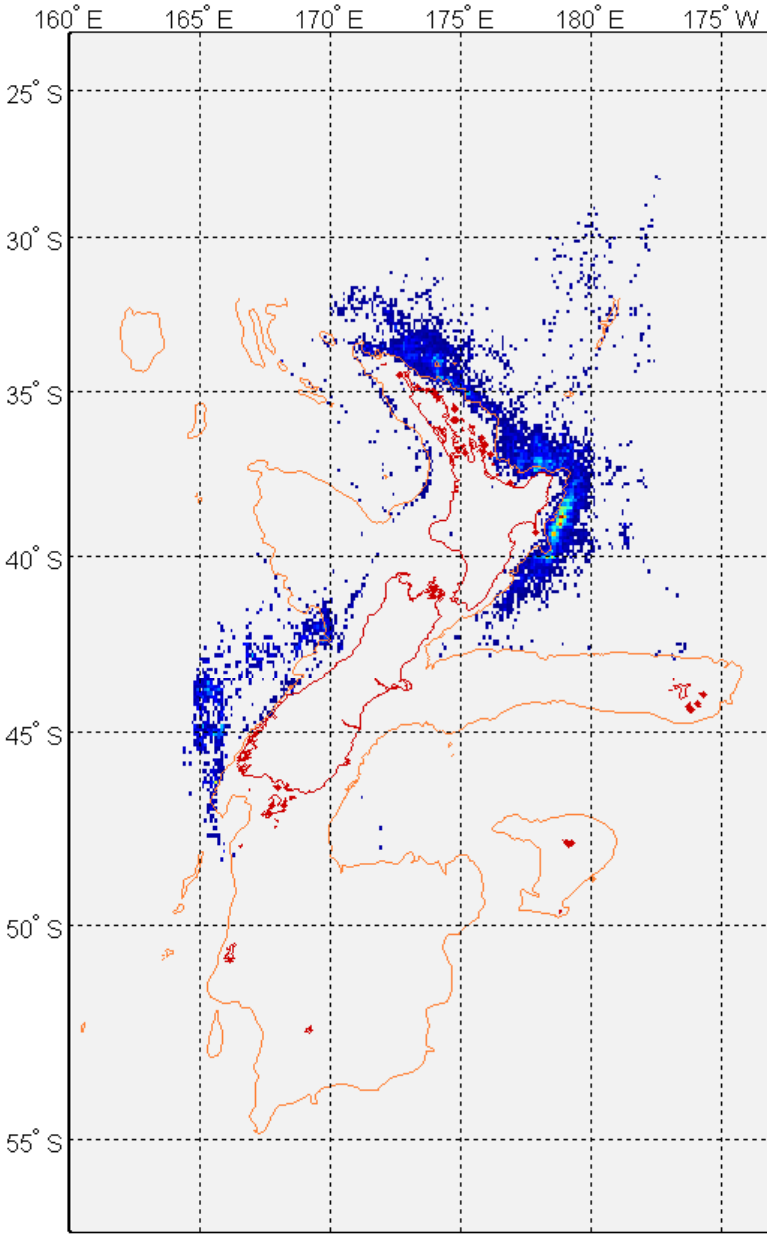
silky, blue, oceanic white tip, pelagic & bigeye threshers, pelagic sting ray

BILLFISH:

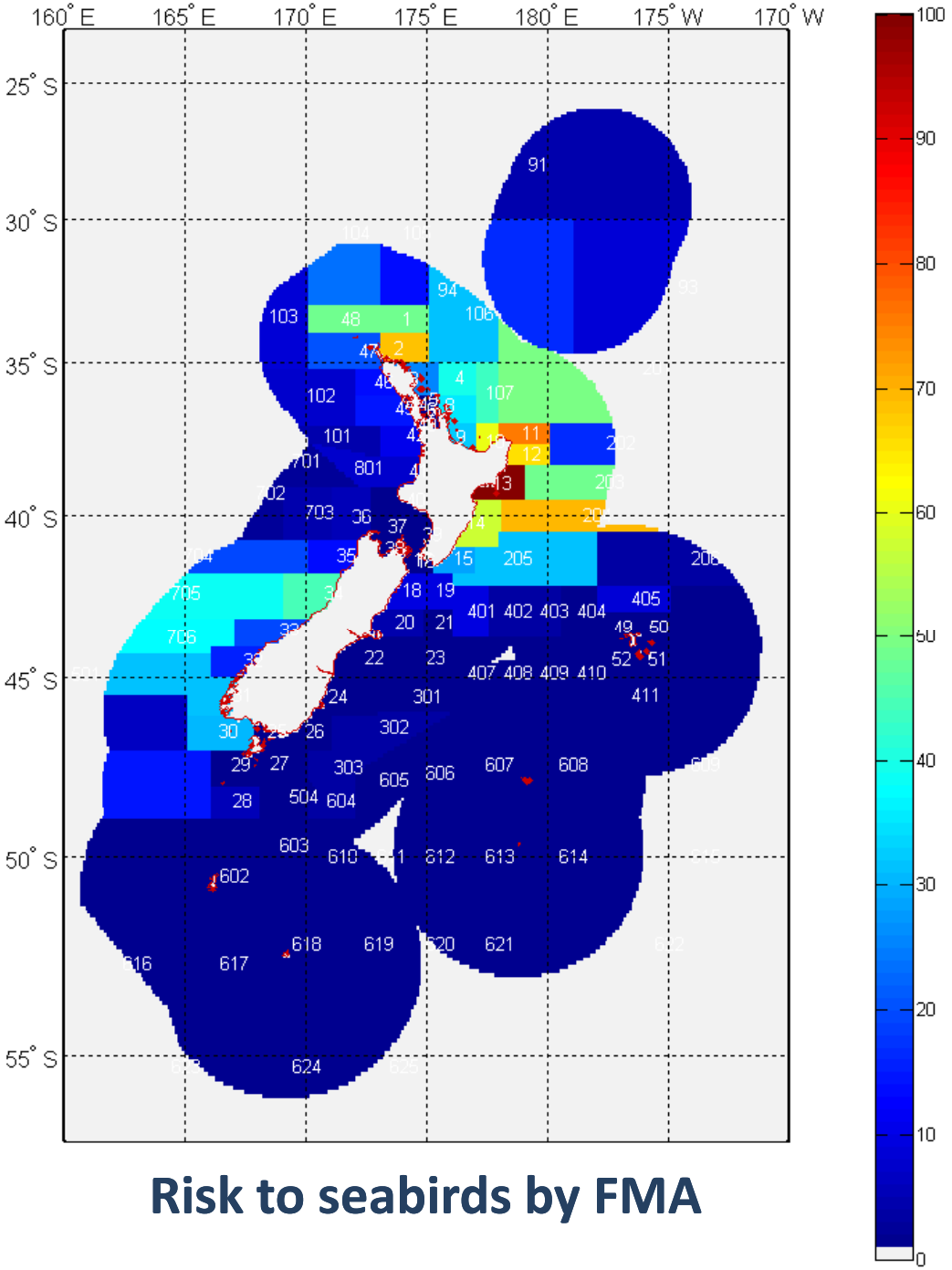
swordfish, blue marlin

Inclusion of spatial aspects and mapping of PSA results

Seabird risk assessment for New Zealand waters (Waugh et al.)



Longline Fishing Effort



Risk to seabirds by FMA

Further analyses for species at high apparent risk in PSAs

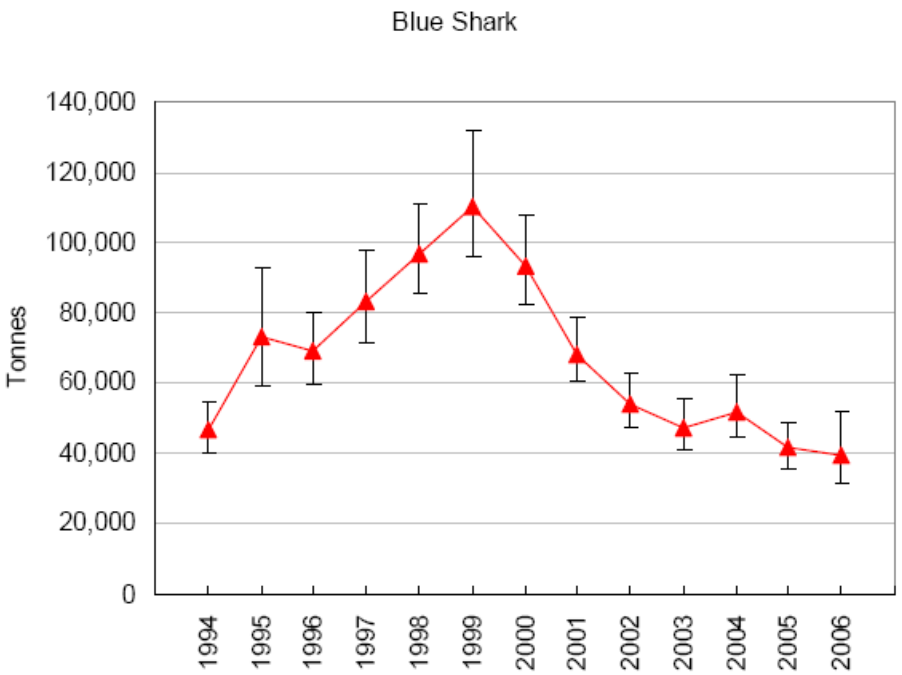
WCPFC has called for stock assessments of 'key shark species'

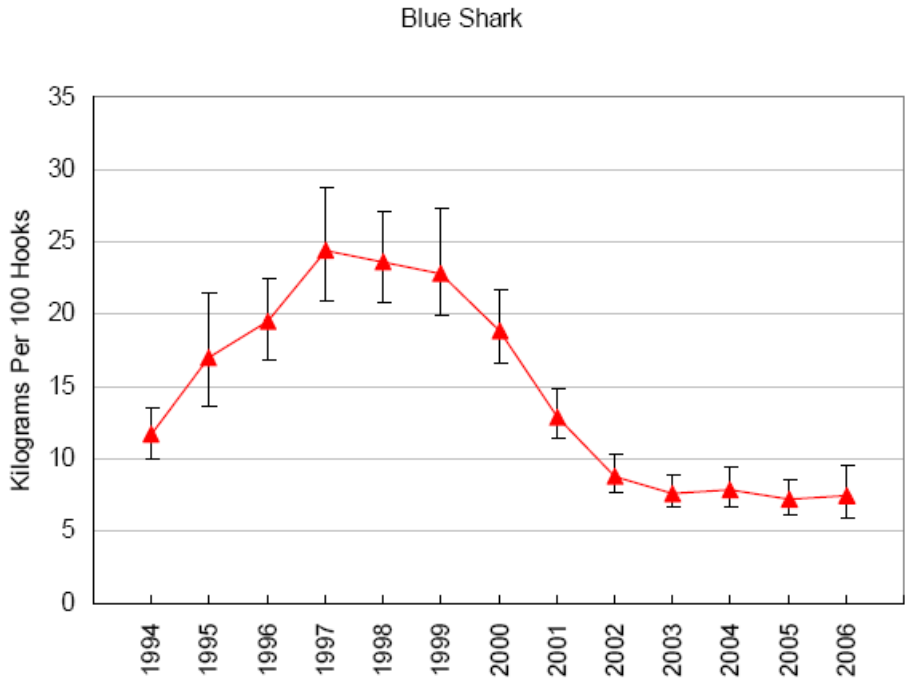
PSAs provide scientific advice as to what is a 'key' species

SC4 has recommended a 'Shark Research Program' starting with a 'feasibility study' for shark stock assessment

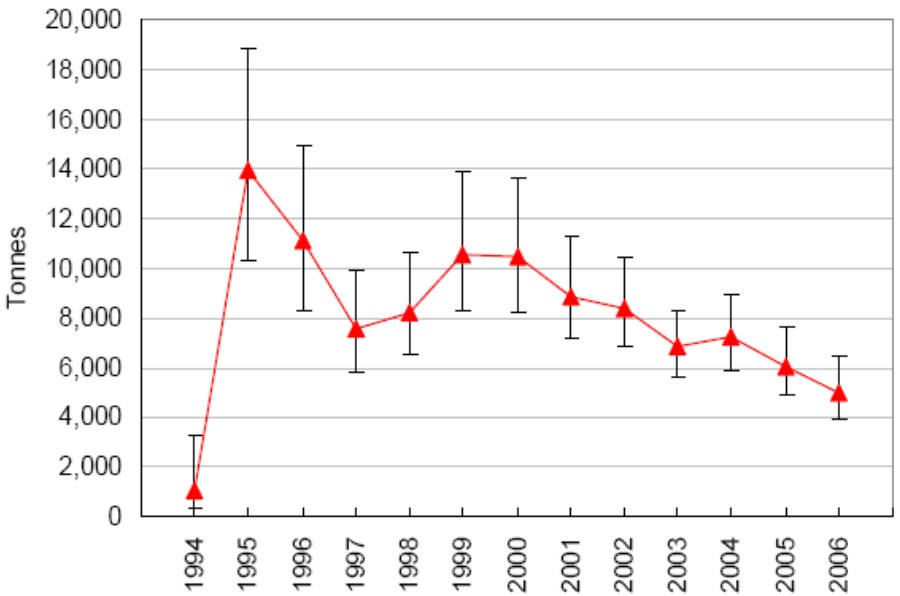
A first task is to develop statistical methods to estimate catches using observer data

Estimates of catches & catch rates for non-target species





Silky Shark



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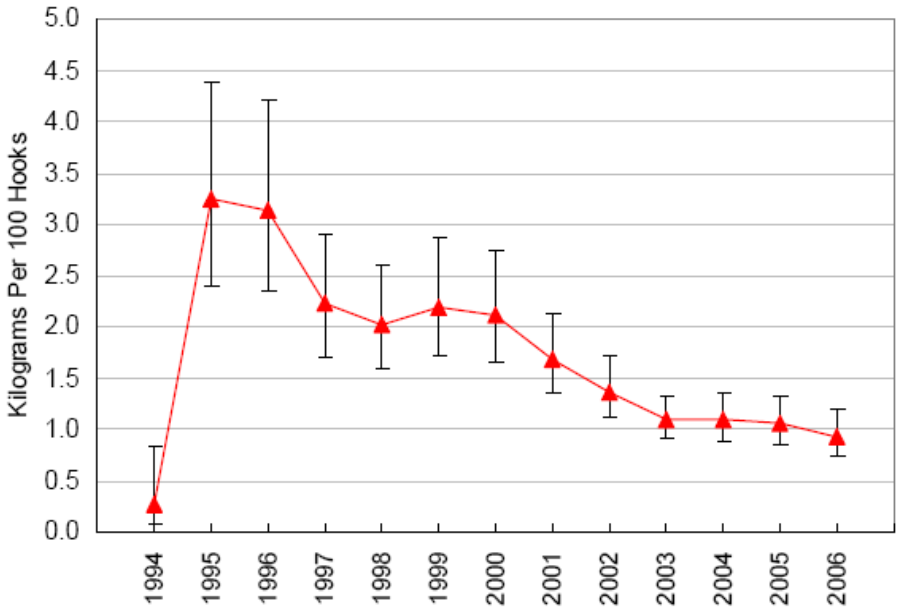
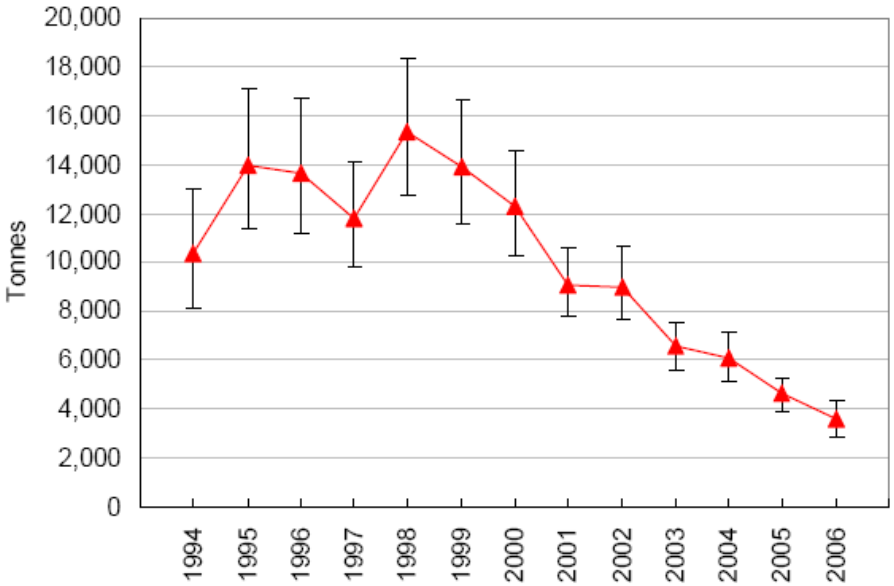


Oceanic Whitetip Shark



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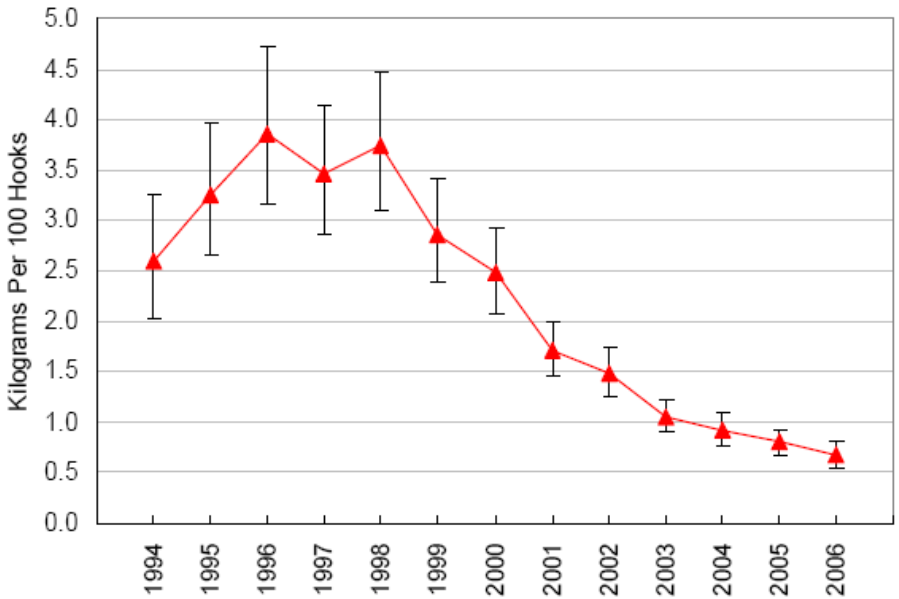

Evaluation of WCPFC Conservation & Management Measures

Examples…

- **Expected decrease in shark mortality from finning ban**

Analysis was presented to SC2 (August 2006) estimating that *fishing mortality on sharks could be reduced by 30% by preventing the removal of fins if the trunk is not retained*; WCPFC3 (December 2006) passed a CMM on sharks banning the removal of fins if the trunk is not retained

- **Vessel-length exemption in WCPFC CMM 2006-05 (Sharks)**

Shark CMM contains an exemption for vessels <24 m in length overall – analysis was presented to SC5 (August 2008) showing that *catch rates for sharks do not vary above/below this threshold* and that, seeing as *ca. 85% of the longline fleet were exempt*, the measure could at best result in a 5% decrease in longline fishing mortality on sharks.

SC and TCC have recommended that the length exemption be removed.

Other 'loopholes' remain, so further analysis will be carried out in 2009.

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Landing of shark carcasses does not necessarily lead to full utilization…

…as dumping of shark carcasses can still take place after landing.

Summary and Conclusions

WCPFC Ecological Risk Assessment (ERA) project provides a framework for bycatch monitoring and assessment in the WCPO

Essential inputs are good quality observer data with coverage that is representative of all gears, fleets, areas and times

Expected outputs are scientific advice about fisheries impacts on bycatch, bycatch mitigation methods and effectiveness of regulations

The project provides a good opportunity for collaboration between the Science Provider and WCPFC members and those IGOS/NGOs with specialist knowledge, e.g. BirdLife Int, ACAP

Some aspects of ERA are probably not suitable to an RFMO context (stakeholder workshops, explicit value-based setting of objectives) but the hierarchical approach to analysis of a large number of bycatch species is very useful, as is the evaluation of management & mitigation measures.

ERA would be applicable to IOTC, given the necessary input data…