出國報告(出國類別：其他)

參加共同海洋鮪魚計畫(Common Oceans Tuna Project)主辦之中西太平洋鮪魚管理研討會會議報告

服務機關：行政院農業委員會漁業署
姓名職稱：尤香宜　技士
派赴國家：印尼峇里島
出國期間：106 年 7 月 31 日至 106 年 8 月 3 日
報告日期：106 年 11 月 1 日

摘要

我國受共同海洋鮪魚計畫(Common Oceans Tuna Project)之邀請，派員參加渠主辦、於 8 月 1 日至 2 日在印尼峇里島舉行之中西太平洋鮪魚管理研討會，除我國外，另有諾魯、尼威、薩摩亞、印尼、瓦利斯和富圖納、泰國、巴拿馬、越南、厄瓜多等中西太平洋漁業委員會會員、合作非會員及參與領地、新加坡商三海私人有限公司、FAO、FFA、WWF、ISSF 及 Ocean Outcomes 等業者、政府間及非政府間組織參加。

前揭共同海洋鮪魚計畫係由聯合國糧農組織(FAO)、印尼政府、國際永續水產基金會(ISSF)及世界自然基金會(WWF)進行合作，本次 WWF 及印尼政府合作舉辦中西太平洋鮪魚管理研討會，旨在討論中西太平洋漁業委員會(WCPFC)漁獲策略及管理策略評估的發展，目的在於協助 WCPFC 會員的管理者更加了解漁獲策略及管理策略評估的內涵，以幫助未來相關議題討論

目錄

壹、 目的

本次會議的目的在於討論中西太平洋漁業委員會(WCPFC)漁獲策略及管理策略評估的發展，協助 WCPFC 會員的管理者更加了解漁獲策略及管理策略評估的內涵，以幫助未來相關議題討論。

近年來區域漁業管理組織開始發展漁獲策略及管理策略評估作為漁業管理之規劃，又 WCPFC 今年將討論並規劃通過新的熱帶鮪及南太平洋長鰭鮪措施，該等鮪類均為我國船隊重要漁獲魚種，而目前草案係以漁獲策略及管理策略評估為基礎發展，我方如能更加瞭解漁獲策略及管理策略評估的內涵及發展、亦有助於我國參與前揭措施的討論。

貳、 會議過程

8月1日(會議第1日)

會議首先由地主國印尼代表團團長 Saut Tampubolon 開幕致詞、FAO 漁業官員 Nicolas L. Guiterrez 介紹共同海洋鮪魚計畫的三大要素及相關計畫執行情形、WWF 介紹此研討會目的，強調漁獲策略(HS)及管理策略評估(MSE)為預警性管理措施，係 WWF 近年來在鮪類 RFMOs 之關鍵倡議，同時並與 ABNJ 的共同海洋鮪魚計畫合作，在斯里蘭卡(2014, 2017)、巴拿馬(2015)、迦納(2016)針對各 RFMOs 舉辦過類此會議。隨後由主持人(Facilitator)Ian Cartwright 引領會議進行，各節情形謹摘要如下：

一、主持人 Ian Cartwright 簡報漁獲策略在中西太平洋漁業委員會(WCPFC)的進展：

(一) WCPFC 在推動漁獲策略上面臨的挑戰為擁有許多立場不同的會員的管理環境，雖然 90%的漁獲位置在南北緯 10 度之間，且其中 70%發生在 PNA 水域，因此 PNA 在其他 FFA 會員的支持下主導此區域的管理趨勢變化，但是中西太平洋各會員有不同的漁具、目標魚種，且有不同的考量，所以漁獲策略目前為止只有逐步的進展。

(二) WCPFC 共舉行過四次管理目標研討會(MOW)，但該會議的討論並未著重於漁獲策略要素且亦非正式的討論，而是由各利益相關者提出其管理目標、表現指標等，在 2014 年的第三次 MOW 會議，與會者討論並支持發展漁獲策略為基礎的管理架構，並在同年通過了相關的養護管理措施(CMM2014-06)。

(三) WCPFC 之 CMM2014-06 中規範漁獲策略要素包括管理目標、參考點、可接受風險層級、監控策略、漁獲控制規則、管理策略評估。至於漁獲策略的發展應以魚種為基礎或以漁業為基礎設定，委員會被期待先以魚種通過限制參考點及可接受風險層級，其他要素則可依魚種及/或漁業為基礎考量，即使漁獲策略一開始係以魚種為基礎發展，若經同意或被要求，亦可轉換為以漁業為基礎，任何針對漁業發展的漁獲控制規則都必須要能達到該漁業主要漁獲魚種的目標參考點。

二、美國 NOAA 學者 Jim Ianelli 簡報漁獲策略的概念：

(一)漁獲策略理論上是一套預先同意的資料處理方式，被用來對管理程序提出建議，而漁獲策略要經過 MSE 的過程，利用各項表現指標及不確定性因素的考量進行測試。

(二)過去的漁業管理通常考量避免我們不想看到的狀況(例如資源崩壞無法回復)，但是在實際情況，若考量預期狀況，則必須與其他利益相關者進行交換(trade-off)，此為管理目標跟表現指標的概念，而要達成管理目標的方式就是漁獲策略，漁獲策略通常是一套決策機制，以漁獲控

制規則為主要概念，並透過控制漁獲量或努力量達成管理目標。

(三)漁獲策略發展後，必須經過 MSE 的測試，MSE 可以視為模擬計算的風險評估工具，MSE 將各種不確定性納入考量，針對各種可能的漁獲策略進行評估分析後，選擇最有可能達到管理目標同時並可有效因應各項不確定性的漁獲策略。

(四)MSE 理想的過程為確認管理目標及表現指標、發展資料估算的模式、發展漁獲策略選項、測試漁獲策略選項、選擇最佳(best)的漁獲策略及執行漁獲策略，且要持續進行績效評估。

三、與會者分組演練

(一) 各組分別基於政策決定者、NGO、業者、科學家的角度討論分享對於最大化經濟產量、最佳化船隊數量、保持漁獲量穩定性、維持產卵群生物量高於限制參考點、降低生態衝擊、開發中國家的特殊需求等六項管理目標的看法。薩摩亞的與會者在分享時，提到政策決定者對於最大化經濟產量、最佳化船隊數量、開發中國家的特殊需求等目標的看法就是採取 Zone-based management。

(二) 各組另外在各與會專家的引領下，針對漁獲策略的各種要素進行排序，漁獲策略的發展順序大致考量到風險及不確定性，管理者希望採取預警性措施，首先訂定管理目標，接著藉由資源評估了解資源現況、各項生物量及漁獲死亡率的數值以決定限制參考點及目標參考點，隨後決定漁獲控制規則、進行 MSE，決定總許可捕撈量(TAC)或總許可努力量(TAE)後，開始執行，並藉由 MCS 措施監控實際執行情形。

四、FFA 科學家 Alice McDonald 簡報 WCPFC 南太平洋長鰭鮪漁獲策略進展:

(一) 目前 WCPFC 進展為管理目標被紀錄及通過限制參考點，而目標參考點、績效指標及可接受風險層級則仍於初步發展狀態，至於漁獲控制規則及管理策略評估則尚待後續相關研究進行發展。

(二) 目前被記錄的管理目標包括生物、經濟、社會及生態系層面。其中則以生物層面的「維持長鰭鮪生物量於可永續利用此漁業資源水準之上」；以及經濟層面的「維持漁獲量穩定及漁獲努力量的可預測性」，為目前南太平洋長鰭鮪漁業主要考量之管理目標。

(三) WCPFC 去年的 SC 會議有一份文件提供針對不同管理策略進行各項假設模擬的分析，例如設定維持漁獲量、努力量、漁業收益穩定為各個管理者提出的不同目標，在維持漁業收益穩定的情況下，必須要削減努力量，而不論馬上削減努力量、逐年削減努力量及到 2024 年才開始削減努力量，都有可能達成結果，但對於未來的生物量及收益都有不同的影響，這些資訊是提供管理者後續評估、利益交換及選擇最適當之漁業管理策略參考，但 WCPFC 去年仍未通過該魚種的目標參考點。今年 SPC 已針對南太平洋延繩釣漁業提出管理目標績效指標，將於下週 SC 會議進行討論。

8 月 2 日(會議第 2 日)

一、紐西蘭科學家 Nokome Bentley 簡報 MSE 的概念：

(一)MSE 主要藉由各項模擬測試以評估不同漁獲策略達到預期目標的程度表現，亦可經由考慮漁業的變動及不確定性，同時於生物、經濟、及社會等各層面取得平衡，並達成一定程度之共識，進而運用於漁獲策略的實施與管理措施的制定。

(二)建構漁獲策略的過程，先擬定管理目標及各項漁獲管理策略，再經由資源評估模式進行各項不同漁獲策略之模擬分析，檢視其結果能否達成預期目標，進而決定最適當之漁業管理措施。

二、隨後與會者則使用電腦應用程式 Tuna MSE，並以黃鰭鮪漁業資源為例進行演練：

(一)首先是藉由調整各年度漁獲限額的方式要求與會者使用程式進行各種模擬，找出最佳的漁獲控制規則，以符合 2016-2050 年間可維持最大漁獲量、資源量有超過 95%的機會維持在系群資源健康狀態且符合 2016-2050 年間漁獲量變動於不超過 10%等要件。

(二)接著除了漁獲限額外，加入了努力量控制、維持生物量及努力量在一定臨界值內的漁獲控制規則，同樣要求與會者使用程式進行各種模擬，找出最佳的漁獲控制規則，以符合 2016-2050 年間可維持最大漁獲量、資源量有超過 60%的機會維持系群資源健康狀態且達到 2016-2050 年間漁獲量變動不超過 20%等要件。

(三)此應用程式主要以不同之管理策略對未來族群動態進行預測(projection)，藉由更動各項參數並計算歷年相對漁獲死亡率(F/F_{MSY})及相對生物量(B/B_{MSY})的軌跡，顯示於 Kobe plot 圖，檢視目前系群模擬分析結果是否過度利用(overfishing：$F > F_{MSY}$)或呈現過漁(overfished：$B < B_{MSY}$)的情況，同時並藉由設定之各表現指標研擬評估並選擇適當之管理策略進行後續漁業資源管理。

(四)此電腦程式可將各項參數設定所得之預測分析結果輸出成圖，以瞭解系群資源量之年間變動情形，利於檢視各項管理控制規則之結果及選定達成管理目標時最適當之管理評估策略。因此在與會者進行模擬後，又再加入不同的漁業管理目標，例如追求最大化漁獲量、維持延繩釣船漁獲量穩定等，要求與會者分別找出符合管理目標又符合前述管理條件的漁獲控制規則。

三、美國 NOAA 學者 Jim Ianelli 以 CCSBT 為例說明 MSE 中利益相關者間利益取捨(trade-off)概念對南方黑鮪的適用：

(一)南方黑鮪資源過度利用而使得系群資源量處於嚴重過漁狀態，南方黑鮪保育委員會(Commission for the Conservation of Southern Bluefin

Tuna, CCSBT)便以南方黑鮪產卵親魚量 SSB 必須恢復至初始資源量水準之 20%作為臨時回復目標，進行南方黑鮪資源復育。

(二)為達成此管理目標與資源復育，CCSBT 在 2001 年通過要求科學委員會建立多年期的重建計畫，經由運算模式的選擇、管理者及利益相關者對管理目標的定義及選擇，最終於 2011 年通過峇里管理程序(the Bali Management Procedure)。

(三)因此在南方黑鮪資源的管理，CCSBT 積極發展 MSE，透過取得科學家、管理者及漁業資源利用者共同認可之運作模式，制訂明確且透明之總可捕量(TAC)管理機制，同時模擬在不同的管理決策下，漁業資源可能的變動趨勢，以期達到最有效管理之目標，報告者同時強調 MSE 過程中利益取捨是必然的，也因此管理者與科學家、管理者與管理者間的溝通十分重要。

四、FFA 科學家 Alice McDonald 簡報對於未來漁獲策略在 WCPFC 發展的展望：

(一)目前 WCPFC 已針對大目鮪、黃鰭鮪、正鰹、南長鰭鮪這 4 個重要魚種紀錄管理目標；

(二)WCPFC 亦針對前述 4 魚種通過限制參考點及可接受風險層級；

(三)WCPFC 已通過正鰹的臨時性目標參考點，針對大目鮪則同意現階段目標為 10 年內重建資源使 SSB 回復到限制參考點，南長鰭鮪的目標參考點將在下周 SC 會議進行討論，黃鰭鮪則預計在 2019 進行討論。

(四)有關績效指標部分，SPC 已針對熱帶延繩釣大目鮪及黃鰭鮪漁業、南太平洋延繩釣漁業提出績效指標建議，將於下週 SC 會議討論。

(五)各魚種的漁獲控制規則預期在 2018 或 2019 年通過，同時 SPC 已在處理進行 MSE 所需的技術工作。

(六)與會者(三海的代表)詢問，WCPFC 在去年通過 10 年內重建大目鮪資源的目標，如果今年大目鮪資源狀況結果良好，這個目標要怎麼調整?報告者回應表示本次大目鮪資源評估使用新的成長方程式故造成資源評估結果差異，如果下週 SC 會議通過並接受此資源評估結果，委員會當然可以視為這個目標已經達成，將再針對大目鮪設新的目標。

參、 心得及建議

心得

一、近年來區域漁業管理組織開始發展漁獲策略及管理策略評估作為漁業管理之規劃，如 WCPFC 等組織已針對重要魚種通過漁獲策略的管理措施及工作計畫，各養護管理措施亦多納入漁獲策略的概念，顯現區域性漁業管理組織中決策討論，科學基礎或科學建議之支持更顯重要，除有助強化論述說服力外，亦有助聚焦取得合理的管理方案。

建議

二、漁獲策略強調預警性的管理、以及管理策略形成的過程中管理者、利益相關者和科學家的參與，其中管理者及利益相關者的角色不同於以往，過去僅被動接受科學建議、於魚種資源量出現問題時訂定漁獲或努力量限額或接受限額限制以確保資源永續發展，管理者及利益相關者在漁獲策略的發展過程中必須先決定發展願景及時程等因子，再由科學家進行分析評估，因此，管理者及利益相關者對漁獲策略管理概念的培養更顯重要，我國尤其應設法建立利益相關者類此概念的瞭解。

肆、附件-會議簡報

COMMON OCEANS

Project: Sustainable Management of Tuna Fisheries and Biodiversity Conservation in the ABNJ

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WWF

Areas Beyond National Jurisdiction: Western and Central Pacific Ocean Tuna Management Workshop

1 and 2 August 2017
Bali, Indonesia

Workshop Aims

The goal of this workshop is to create a better understanding among Western and Central Pacific Ocean States of the precautionary approach, harvest strategies (HSs) and management strategy evaluation (MSE) for sustainable tuna fisheries in the context of tuna fisheries.

Ultimately, the objective of this workshop is to accelerate the development of tuna HSs within the Western and Central Pacific Ocean by creating a unique agenda that considers some of the key elements of fisheries management issues currently relevant to Western and Central Pacific Ocean Fisheries Commission (WCPFC) members. Participation in this workshop will empower coastal states to engage meaningfully in the developments that are occurring with Western and Central Pacific Ocean tuna management over the coming two-

four years.

The Event

The workshop program will include discussion of harvest strategy frameworks and the current Western and Central Pacific Fisheries Commission (WCPFC) management strategy evaluation (MSE) process. It will further equip participants with the skills and background necessary for effective and informed participation in the development of Western and Central Pacific Ocean harvest strategies. Using an innovative and 'hands on' simulation tool workshop participants will learn how MSEs can test and contribute to the development of robust control rules within an overall harvest strategy approach. To avoid contention, the workshop will present general examples of control rules, focusing on principles and process, rather than the specifics of proposed harvest strategies for WCPFC stocks.

The workshop will complement and support the capacity building that has already been delivered to WCPFC members, including through the Management Options Workshop (MOW) process and the work that the Pacific Community (SPC) is about to initiate for the countries in the region. We believe that the workshop will assist Commission members to understand and appreciate the value of robust and well-tested (via MSE) harvest strategies, and thereby engage effectively at future international negotiations. It will be aimed at East and Southeast Asian countries although open to all Members, Participating Territories and Cooperating Non-member(s) the WCPFC. We therefore strongly encourage fisheries managers/directors, together with their scientific advisors, to consider attending this workshop. It is anticipated that a second workshop later in the year aimed at Pacific Island states will be announced in the near future.

Workshop context

The workshop is part of the "Sustainable Management of Tuna Fisheries and Biodiversity Conservation in Areas Beyond National Jurisdiction" (ABNJ Tuna Project).

On 5 November 2013, the Global Environment Facility approved the five-year ABNJ Tuna Project, which the United Nations Food and Agriculture Organization coordinates. The overarching project will focus on three component areas:

1) Supporting implementation of sustainable and efficient fisheries management and fishing practices
2) Reducing illegal, unreported and unregulated fishing through strengthened and harmonized monitoring, control and surveillance
3) Reducing ecosystem impacts from tuna fishing, including bycatch and associated species

WWF is the lead agency for a number of the ABNJ Tuna Project outputs, including supporting the improved understanding of the application of the precautionary approach through HSs by tuna Regional Fisheries Management Organisations (RFMOs). This series of workshops,

together with support to science-management dialogues (led by FAO), fall under the first component of the Project.

The activities of the ABNJ Tuna Project are designed to supplement and reinforce existing efforts, not duplicate them, so these workshops are organized with the cooperation of existing initiatives in each of the oceans. In the case of the WCPO, there is cooperation and coordination with SPC, the organization in charge of developing most of the WCPFC MSE work, and bring together experts who are familiar with the history of the development of this work in the region.

This workshop is the first of two rounds of workshops for the WCPO, similar to RFMO capacity building workshops that are also being held for the Indian, Atlantic and Eastern Pacific Oceans for the 5-year life of the ABNJ tuna project.

DRAFT Agenda

DAY ONE – 1 August 2017

0800 – 0850	**Registration**	
0900 – 0940	**Opening and introductions** • Official Indonesia Government welcome and opening • ABNJ overview • WWF Introduction • Workshop in the context of WCPFC processes	Ian Cartwright, Facilitator Reza Shah Pahlevi Nicolas Gutierrez Wawan Ridwan Ian Cartwright
0940 – 1030	**Context setting overview** • Why we are here: benefits and harvest strategy concepts • Group Q&A	Jim Ianelli Ian Cartwright
1030 – 1100	**Break**	
1100 – 1230	**Small group session 1 – Management objectives - the basis for developing harvest strategies:** exploring perspectives • Breakouts	Ian Cartwright
1230 – 1330	**Lunch**	
1330 – 1500	**Small group session 2 – Harvest strategy concepts:**	Ian Cartwright

	exploring and sharing participants' understanding • Breakouts	
1500 – 1530	**Break**	
1530 – 1550	**Session 2 continued - what did we learn** • Facilitated discussion	Ian Cartwright
1550 - 1650	**Concepts: going deeper** • Strengthening key concepts and providing more depth • Albacore – Case study presentation	Jerry Scott and Ian Cartwright Alice McDonald
1650 – 1700	**Day 1 wrap up** – Facilitated discussion	Ian Cartwright
1700	**Close Day 1**	

DAY TWO – 2 AUGUST 2017

0900 - 0910	**Opening: Day 1 reflections, Day 2 overview**	Ian Cartwright
0910 - 0930	**Management Strategy Evaluation (MSE) Concept Overview** • Role of management strategy evaluation (MSE)	Nokome Bentley
	Demonstration of MSE tool	
0930 - 1030	**Exercise 1 Stock assessments and manual projections** Presentation, exercise and facilitated discussion	Nokome Bentley and Ian Cartwright
1030 - 1100	**Break**	
1100 - 1230	**Exercise 2 Designing and comparing HCRs** Presentation, exercise and facilitated discussion • How to test decision choices on key management inputs Simple automatic harvest control rule	Nokome Bentley
1230 - 1330	**Lunch**	
1330 - 1500	**Small group session 3 – Creating harvest control rule (HCR) scenarios and evaluating trade-offs; final HCR challenge and 'fun competition'** Hands-on testing of harvest control rule options and discussion of trade-offs among competing objectives, performance measures • Breakouts and round table discussions	Nokome Bentley

1500 - 1530	**Break**	
1530 - 1600	**Looking ahead: WCPFC process on harvest strategy development** **Other Tuna RMOs experiences with harvest strategy development**	Jim Ianelli Jerry Scott
1600 - 1630	**What did we learn – how will we use it in WCPFC?** • Facilitated discussion	Ian Cartwright
1630 - 1700	**Evaluation and farewell** • Workshop evaluation • Closing thanks and send-off	Ian Cartwright WWF Indonesia

Abbreviations/Acronyms

ABNJ	Areas Beyond National Jurisdiction
FAO	United Nations Food and Agriculture Organization
HCR	Harvest Control Rule
HS	Harvest Strategy
WCPFC	Western and Central Pacific Ocean Fishery Commission
MSE	Management Strategy Evaluation
RFMO	Regional Fisheries Management Organization

Food and Agriculture Organization
of the United Nations

gef

Common Oceans ABNJ Tuna Project: a global partnership for sustainability

Nicolas L. Gutierrez
Fishery Resources Officer, FAO
Common Oceans ABNJ Tuna Project LTO

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Global sustainable fisheries management and biodiversity conservation in the Areas Beyond National Jurisdiction Program

- **A broad-scale approach to achieve efficient and sustainable management of fisheries resources and biodiversity conservation in ABNJ;**
- **Funded by the GEF (50 millions USD, co-financing 280 millions) and includes 4 projects:**

Sustainable Management of Tuna Fisheries and Biodiversity Conservation in the ABNJ "Tuna Project"

Sustainable Fisheries Management & Biodiversity Conservation of Deep-sea Ecosystems in the ABNJ "Deep Seas Project"

Ocean Partnerships for Sustainable Fisheries and Biodiversity Conservation – Models for Innovation and Reform "OPP"

Strengthening Global Capacity to effectively manage ABNJ "Capacity Project"

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Common Oceans ABNJ Tuna Project

Food and Agriculture Organization of the United Nations

Implementation by FAO

gef

US$ 27 million from GEF for 5 years starting in 2014

Co-financing
US$ 150.8 million coming from all Project Partners

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Project Partners

Tuna RFMOs

- CCSBT
- IATTC
- ICCAT
- IOTC
- WCPFC

National governments

- Government of Ghana
- Government of Fiji
- US NOAA

Private sector

- ISSF/A
- Fiji Tuna Boat Owners Association now Fiji Fishing Industry Association

International NGOs

- WWF
- BirldLife International

International and sub-regional organizations

- ACAP
- OSPESCA
- FFA
- PNA
- Pacific Community

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ABNJ Tuna Project – Main components

Component 1 Sustainable management

- Support to t-RFMO's adoption of harvest strategies
- Capacity development on harvest strategies for delegates to ensure effective participation
- Support preparation of EAF plans at RFMO level

Component 2 Strengthening MCS and compliance

- Capacity building through a global certification program for MCS officers
- Compliance improvement in eligible t-RFMO members
- Port State measures template legislation
- Pilot trials in electronic monitoring on board vessels

Component 3 Reducing ecosystem impacts

- Integrated shark management plans across the Pacific
- Trials for mortality reduction of seabirds in longliners
- Trials for bycatch reduction in purse seiners
- Global Bycatch Management and Information Portal

ABNJ Tuna Project – Some outcomes

Component 1

- Harvest Control Rules adopted for IO skipjack and EPO tropical PS fishery (2016)

Component 2

- Consolidated List of Authorized Vessels (for tuna) is online and updated daily http://tuna-org.org/

Component 3

- Recommendations for shark data improvement initiatives adopted by the WCPFC (observer programs / minimum data)
- WCPFC adopted safe release guidelines for encircled animals including whale sharks

COMMON OCEANS

Thank you!

COMMON OCEANS

Component 1 - Sustainable management

1. Support to t-RFMO's **adoption of Harvest Strategies**

   - Support for Science-management dialogues and management strategy evaluation
   - Support to Kobe Joint WG on MSE in 2016

2. **Capacity development on Harvest Strategies** for delegates to ensure effective participation

   - WWF organized four capacity building workshops in the Indian/Atlantic/Eastern Pacific Oceans

   Harvest Control Rules adopted for IO skipjack and EPO tropical PS fishery (2016)

3. Support **Ecosystem approach to fisheries management** plans at RFMO level

- Ecosystem approach joint tuna RFMO meeting, with ICCAT lead. 12-14 December 2016 in Rome, follow-up meeting planned for late 2017

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Component 2 - Strengthening MCS and compliance

1. Development and endorsement of **MCS Best Practices**
2. Creation of a **Tuna MCS Network(s)** Facilitate cooperation among compliance officers
3. Establishment of **certification-based MCS course**
4. C**ompliance improvement** in eligible t-RFMO members (compliance missions, electronic reporting)

Port State measures legislative template, currently being used by FAO in PSMA capacity building activities globally

Pilot trials in electronic monitoring on board vessels (Ghana, Fiji, Seychelles))

Review of **Catch Documentation Schemes** and design options for tuna CDS

CLAV (online Consolidated List of Authorized Vessels; updated daily http://tuna-org.org/

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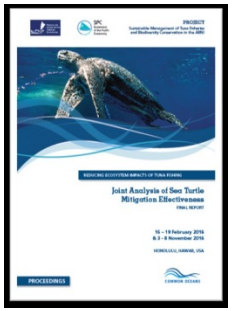
Component 3 – Reducing ecosystem impacts

1. Integrated shark management across the Pacific

- Global shark data inventory completed, currently available as ppt
- New inter-RFMO sharks assessments: Bigeye Thresher completed, Southern Porbeagle underway, Silky shark under preparation
- ★ Rec for shark data improvement initiatives adopted by the WCPFC (observer programs / data)
- ★ WCPFC adopted safe release guidelines for encircled animals including whale sharks

2. Global Bycatch Management and Information Portal and new data on mitigation effectiveness

- Analysis of bycatch mitigation effectiveness for sea turtles completed
- Shark post-release mortality tagging studies



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Component 3 – Reducing ecosystem impacts

Mitigation of incidental mortality of birds in longline fleets led by BirldLife

- Seabird bycatch assessment workshops
- Observer trainings
- Port-based outreach Program

Trials for bycatch reduction in purse seiners

- ISSF working on behavior of sharks and small tunas under FADs

Observer program in gillnet fisheries in the northern Indian Ocean led by WWF

- Estimate bycatch rates, currently 12% observer coverage in Pakistan

COMMON OCEANS

COMMON OCEANS

WESTERN & CENTRAL PACIFIC OCEAN

TUNA MANAGEMENT WORKSHOP

BALI, INDONESIA | 1ST - 2ND AUGUST 2017

WWF Lead Agency Introduction

SUPPORTED BY:

OCEAN OUTCOMES

ABNJ W Pacific Ocean Tuna Management Workshop
Bali, Indonesia, 1-2 August 2017

The workshop is part of the ABNJ Tuna Project “Sustainable Management of Tuna Fisheries and Biodiversity Conservation in Areas Beyond National Jurisdiction”

The project is focused on three component areas:

1. Promotion of sustainable management
2. Strengthening and harmonizing Monitoring Control and Surveillance
3. Reducing ecosystem impacts

ABNJ W Pacific Ocean Tuna Management Workshop
Bali, Indonesia, 1-2 August 2017

WWF is the lead agency for several ABNJ Tuna Project outputs, including increasing the understanding and application of Harvest Strategies by tuna Regional Fisheries Management Organisations (RFMOs).

This Bali Workshop is part of a series of workshops for each RFMO addressing the project component: promoting sustainable management

ABNJ W Pacific Ocean Tuna Management Workshop
Bali, Indonesia, 1-2 August 2017

Outcome 1.1
Improved management decision making concerning tuna and associated species in the areas under the jurisdiction of the five t-RFMOs.

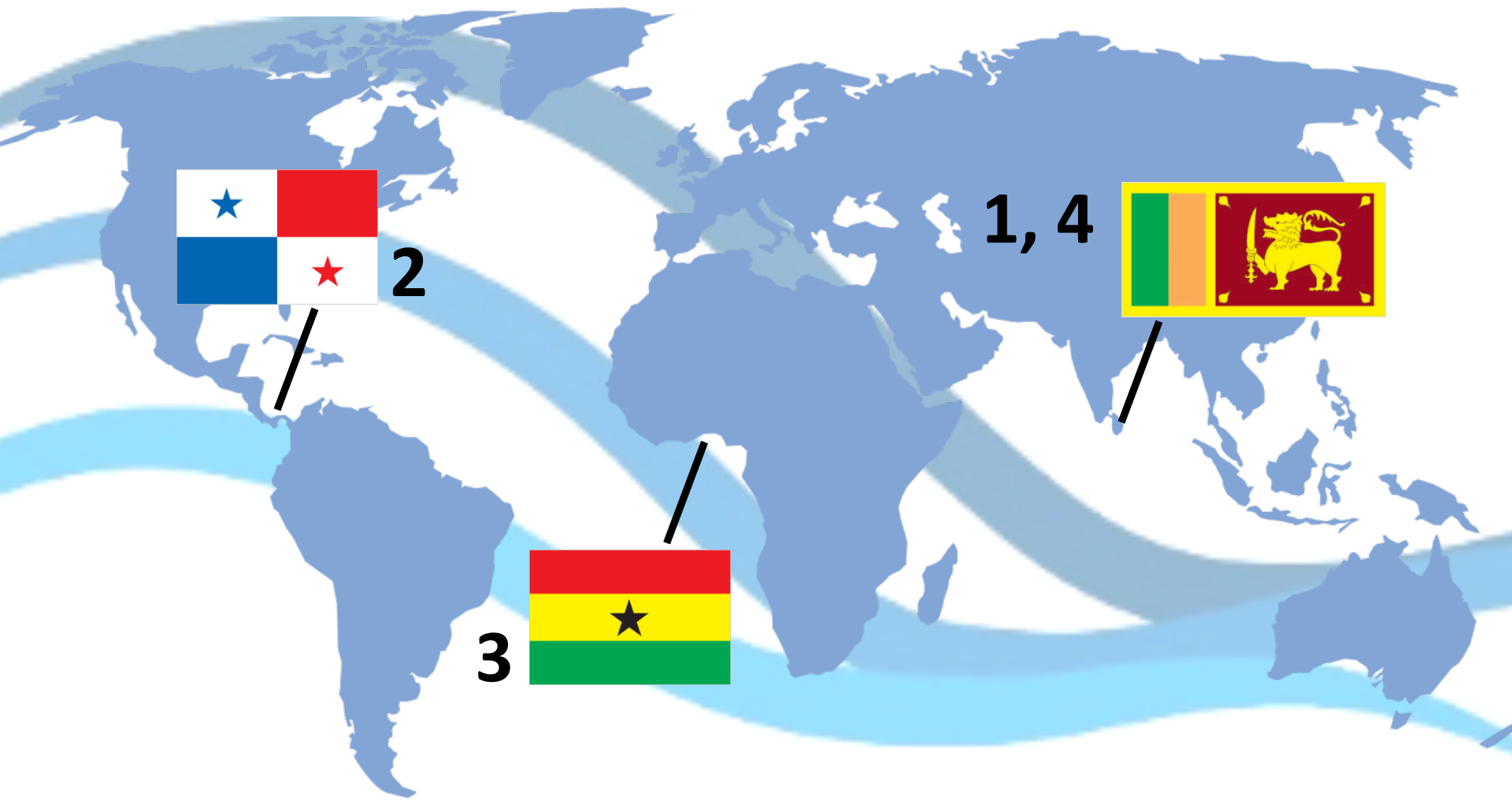
ABNJ W Pacific Ocean Tuna Management Workshop
Bali, Indonesia, 1-2 August 2017

Outcome 1.1
Improved management decision making concerning tuna and associated species in the areas under the jurisdiction of the five t-RFMOs.

Outcome 1.1.1

At least ten developing coastal states support the successful adoption of a Conservation and Management Measure (CMM) or CMMs at the RFMO-level that implement the elements of a Harvest Strategy for regional stock

ABNJ W Pacific Ocean Tuna Management Workshop
Bali, Indonesia, 1-2 August 2017



ABNJ W Pacific Ocean Tuna Management Workshop
Bali, Indonesia, 1-2 August 2017

This workshop builds on previous to consider key elements of fisheries management issues currently relevant to WCPFC members.

Participation will empower you to engage meaningfully in the ongoing discussions on harvest strategies for Western Pacific Ocean tuna stocks over the coming two-four years

ABNJ W Pacific Ocean Tuna Management Workshop
Bali, Indonesia, 1-2 August 2017

Sustainable Management of Tuna Fisheries and Biodiversity Conservation in the Areas Beyond National Jurisdiction

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WESTERN & CENTRAL PACIFIC OCEAN

TUNA MANAGEMENT WORKSHOP

BALI, INDONESIA | 1ST - 2ND AUGUST 2017

INTRODUCTION AND CONTEXT

KEMENTERIAN KELAUTAN DAN PERIKANAN

FAO FIAT PANIS

gef

ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

WWF

SUPPORTED BY:

OCEAN OUTCOMES

North Sea Cod and my part in their downfall

A message from WCPFC Chair, Rhea Moss-Christian

“Harvest strategy work will continue to feature prominently in the Commission's Annual Session work, building on progress achieved last year. Increasing the capacity of Commission participants is essential if meaningful engagement in the development of appropriate fisheries management arrangements is to occur. The work of the ABNJ programme running workshops such as this one will assist greatly to inform and prepare Commission participants for upcoming discussions on harvest strategy”

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Early days of WCPFC

- Driven by the UN Fish Stocks Agreement (UNFSA)
- The Multilateral High Level Conference (MHLC) in Fisheries re-commenced in 1997 and finished in 2000 with the completion of the ***Convention for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean***
- The Convention came into force in 2004 and the Commission was established in 2005

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WCPF Convention

- The WCPF Convention is the latest of the RFMO treaties to be negotiated.
- It reflects the language of the UN Fish Stock Agreement (UNSFA) closely, with a requirement to implement the Precautionary approach using Annex 2 of UNSFA
- Annex 2 talks of:
  - limit and target reference points **(LRPs and TRPs**);
  - the triggering of 'pre-agreed conservation and management action' (**decision/control rules)** when stocks reach a particular state;
  - the requirement for a **very low risk** of breaching LRPs; and
  - Level of fishing mortality to achieve **MSY** as a minimum

COMMON OCEANS

The WCPO management challenge

- Immensely complex management environment involving very different member states.
- 90% of the total tuna catch is taken 10^0N-10^0S , 70% of which is in the waters of the PNA; hence this group, generally backed by other FFA states, have driven management change.
- Multi-gear, multispecies fisheries, with fishing mortality occurring on the same species at different sizes/ages (yellowfin and bigeye).
- Generally a piece-meal approach to HS owing to difficulties in reaching consensus on contentious issues.
- Progress with a wide range of technical measures (CMMs), LRPs and an interim skipjack TRP.

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Developing harvest strategies

- Four Management Options Workshops (MOW) 2012-2015,
  - Last focussed on Harvest Strategies
  - Unofficial, free-flowing discussion, including on objectives, targets, indicators etc which resulted in the 'Strawman'
- MOW 3 (2014): Discussed and supported the development of a harvest strategy-based management framework.
- WCPFC 11 (2014) adopted CMM-2014-06 (*CMM to develop and implement a harvest strategy approach for key fisheries and stocks in the WCPO*).

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Provision of scientific advice

In respect of the Commission, the Oceanic Fisheries Programme (OFP) of the South Pacific Fisheries Commission:

i. processes and manages data from commercial tuna fishing fleets
ii. provides stock assessment and related advice on the status of tuna and other affected pelagic fish stocks,
iii. provides the scientific services in i) and ii) above to WCPFC under an annual service agreement; and
iv. undertakes other scientific analysis, including evaluation of management measures and management strategy evaluation (MSE) on a contract/project basis

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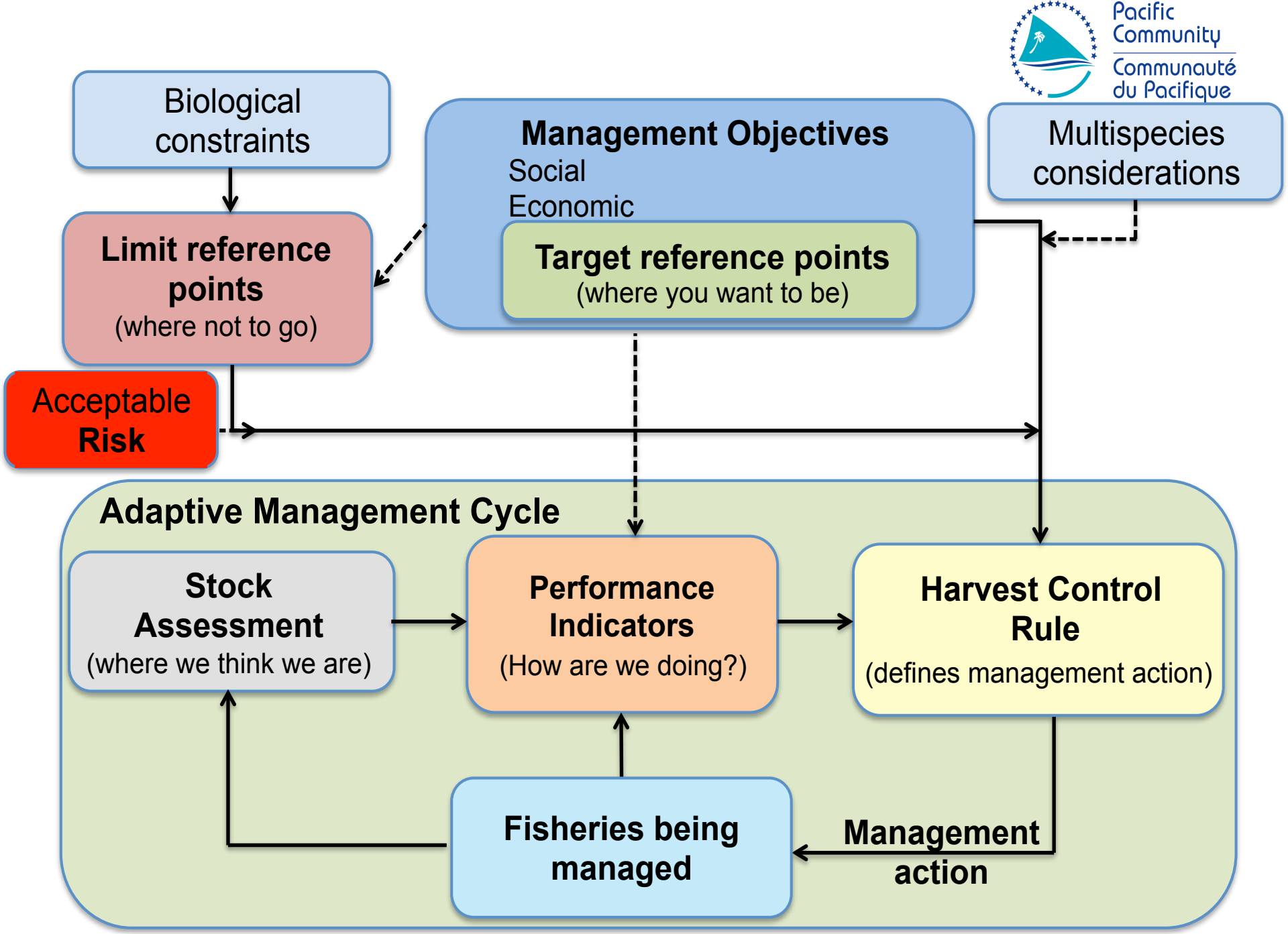
Pacific Community
Communauté du Pacifique
Biological constraints
Management Objectives
Social
Economic
Multispecies considerations
Limit reference points
(where not to go)
Target reference points
(where you want to be)
Acceptable Risk
Adaptive Management Cycle
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(where we think we are)
Performance Indicators
(How are we doing?)
Harvest Control Rule
(defines management action)
Fisheries being managed
Management action

Harvest strategy workplan

"The Commission shall agree a workplan and indicative timeframes to adopt or refine harvest strategies for skipjack, bigeye, yellowfin, South Pacific albacore, Pacific bluefin and northern albacore tuna by no later than the twelfth meeting of the Commission in 2015. This workplan will be subject to review in 2017. The Commission may agree timeframes to adopt harvest strategies for other fisheries or stocks".

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Elements of a harvest strategy

- Defined operational objectives, including timeframes, for the fishery or stock **('management objectives')**
- Target and limit reference points for each stock **('reference points')**
- Acceptable levels of risk of not breaching limit reference points **('acceptable levels of risk')**
- A monitoring strategy using best available information to assess performance against reference points **('monitoring strategy')**
- Decision rules that aim to achieve the target reference point and aim to avoid the limit reference point **('harvest control rules'),** and
- An evaluation of the performance of the proposed harvest control rules against management objectives, including risk assessment **('management strategy evaluation')."**

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Stock or fishery-based harvest strategies

- Anticipated that the Commission will agree LRPs and acceptable levels of risk of breaching them at the stock level
- All other harvest strategy elements, including objectives, target reference points, HCRs, and monitoring strategies, may be developed for stocks and/or fisheries
- Assumed that harvest strategies will be initially developed on a stock-specific basis
- Can be adjusted to a fishery basis as required/agreed
- Any HCRs developed for fisheries should be designed and evaluated to achieve the TRP for each of the [main] stocks caught by that fishery

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WCPFC Progress

- **LRPs for key tuna** species agreed (20% of the spawning biomass in a absence of fishing, using the average of the last 10 years
- **TRP for Skipjack (50%** of the spawning biomass in a absence of fishing, using the average of the last 10 years
- **For acceptable risk of breaching LRPs** consider HCRs where the estimated risk of breaching the limit reference point is between 0 and 20%.
- **Rebuilding target for bigeye:** interim timeframe of up to ten years to rebuild to the agreed Limit Reference Point of $0.2SB_{F=0}$
- **Preparatory work on TRPs for southern albacore** (see case study)

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Thank you!

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WESTERN & CENTRAL PACIFIC OCEAN

TUNA MANAGEMENT WORKSHOP

BALI, INDONESIA | 1ST - 2ND AUGUST 2017

Intro to harvest strategies

KEMENTERIAN KELAUTAN DAN PERIKANAN

FAO FIAT PANIS

gef

ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

WWF

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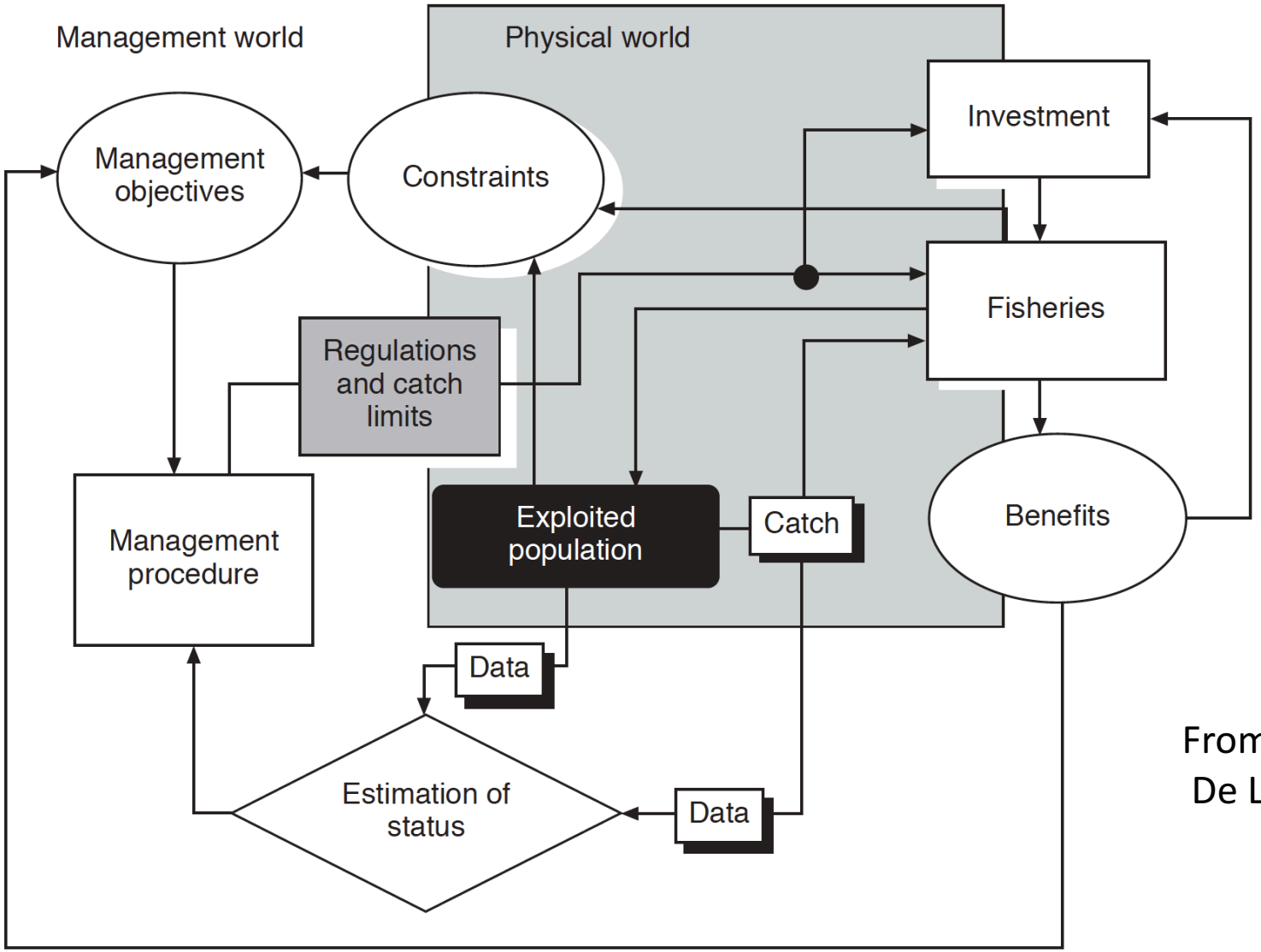
How do we evaluate a Harvest Strategy?



From:
De La Mare (1998)

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Fig. 1. A schematic overview of fisheries management as a system.

Fish mgt?

"Water" by Giuseppe Arcimboldo (1527–1593). Kunsthistorisches Museum, Vienna.

A Fisheries management framework "Harvest Strategy"

Ideally:

1. Pre-agreed **treatment** of **data** for recommending management action

2. Tested using Management Strategy Evaluation
   - Using performance indicators and
   - Considers uncertainty

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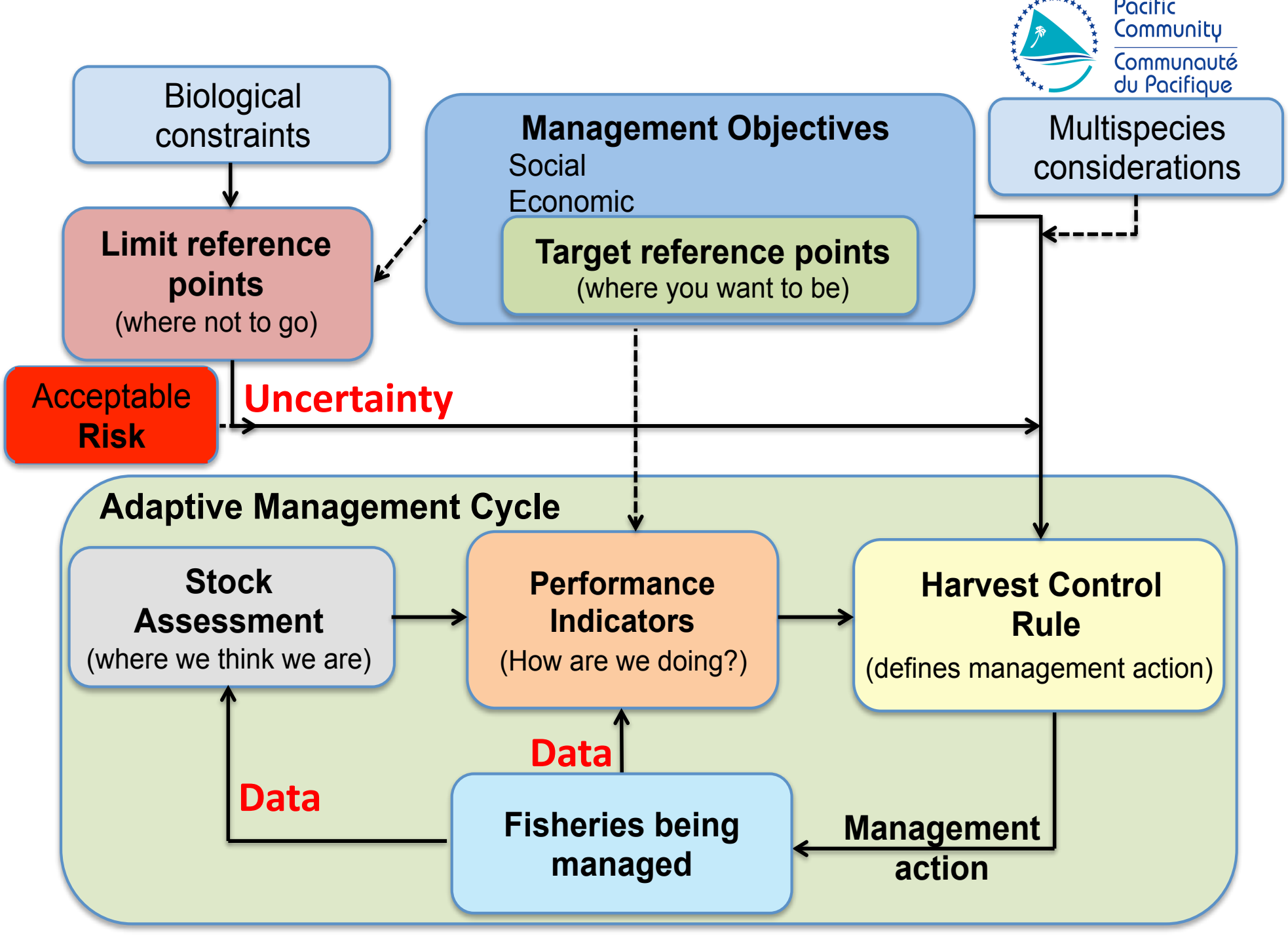
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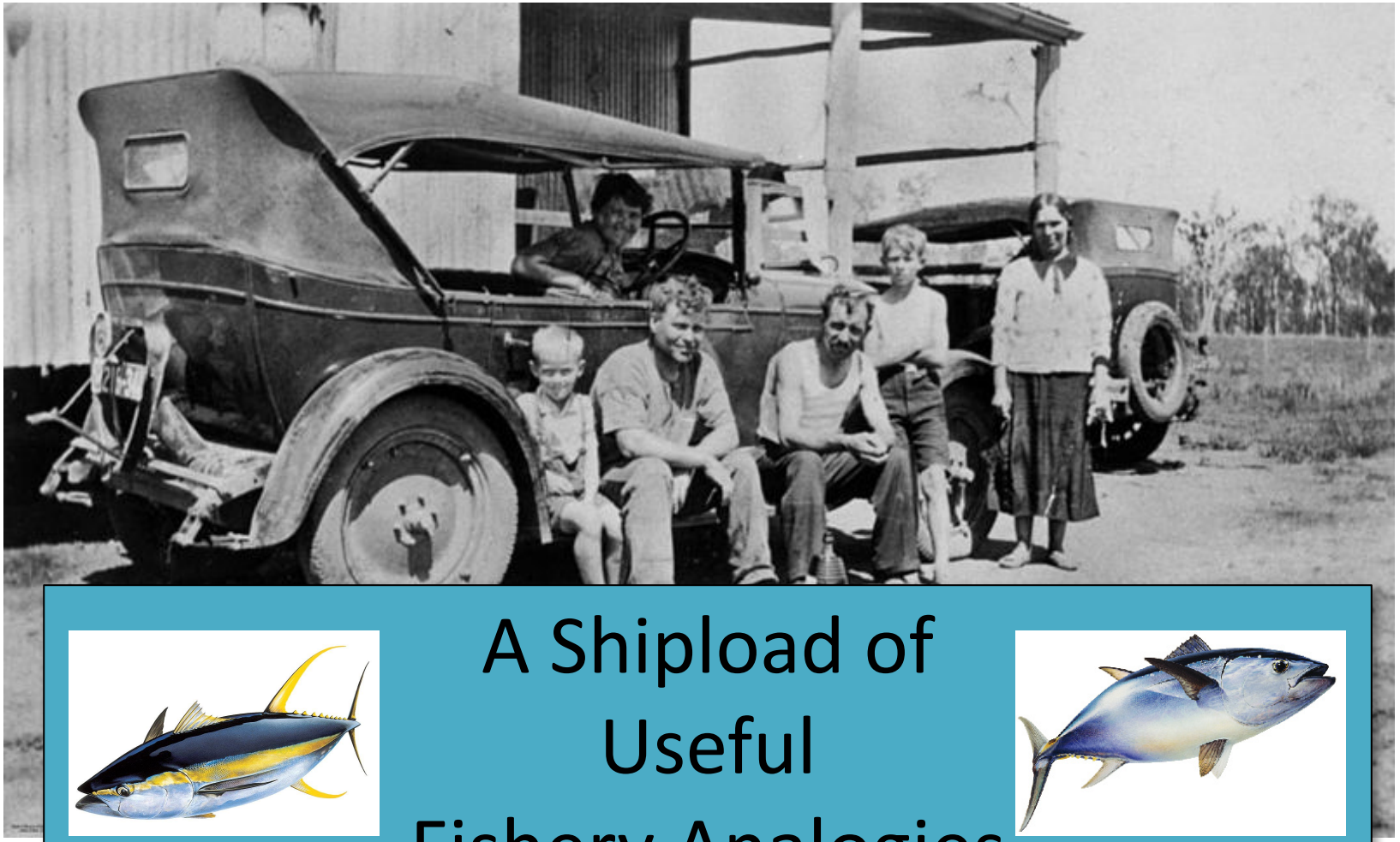
(defines management action)
Data
Data
Fisheries being managed
Management action

Framework context…
the Family Vacation



A Shipload of
Useful
Fishery Analogies

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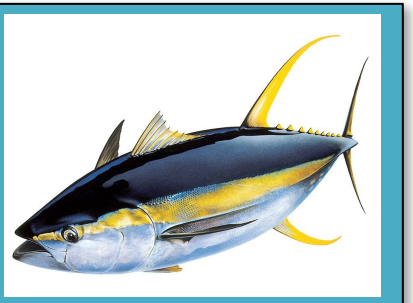
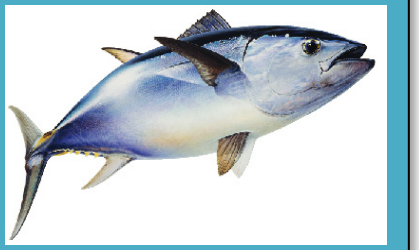
It goes without saying:

Don’t crash the car!



Don’t crash the population!



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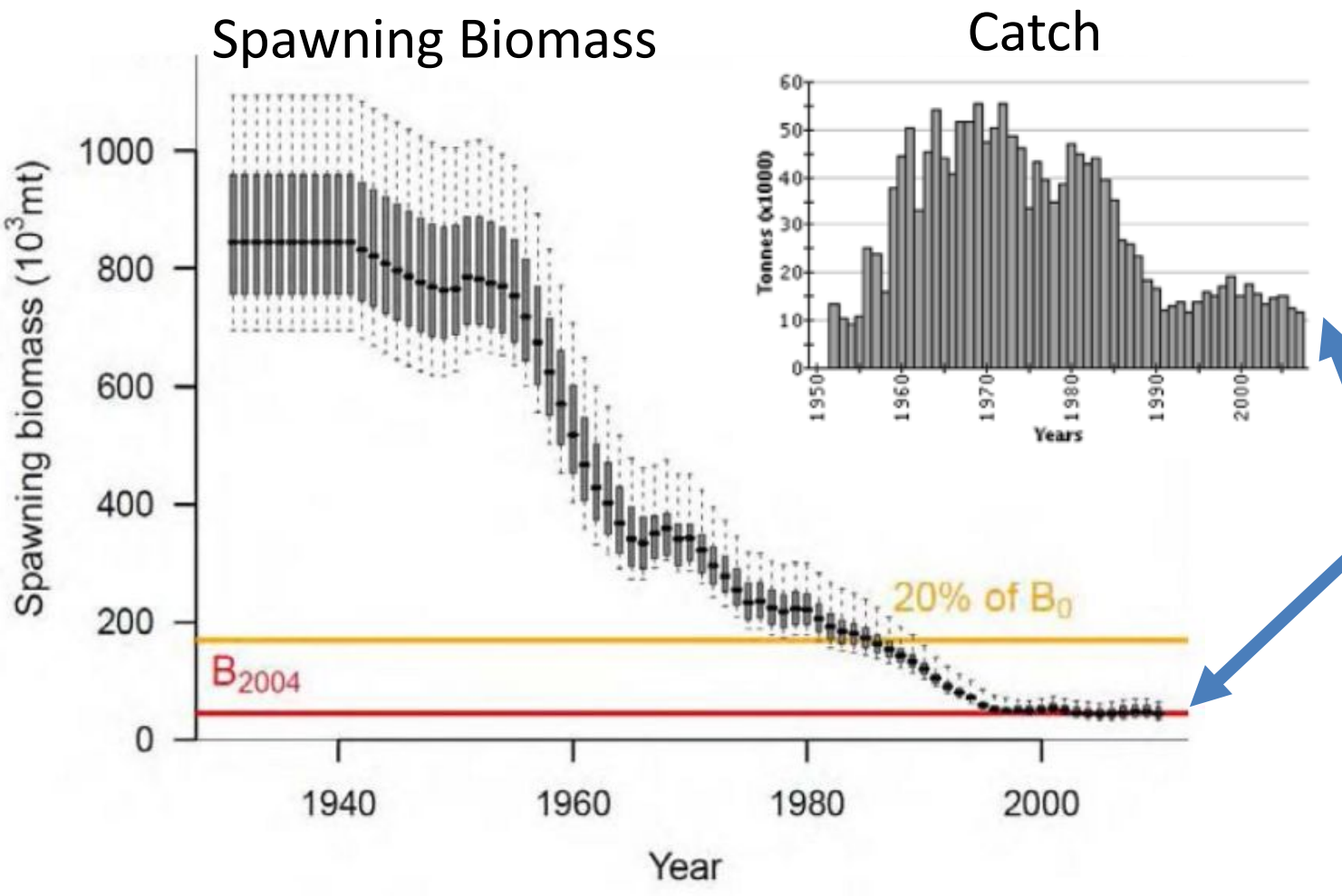
Southern Bluefin Tuna

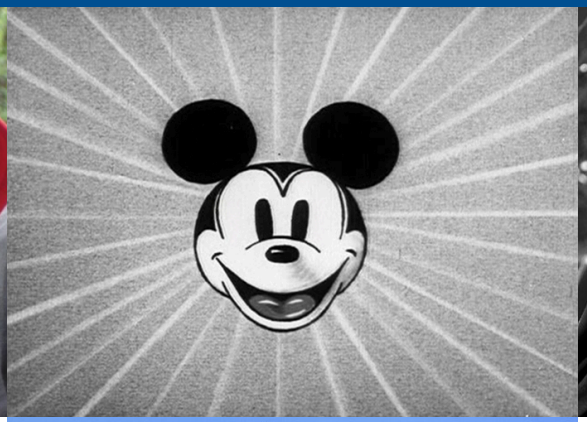


We don't want to be here!

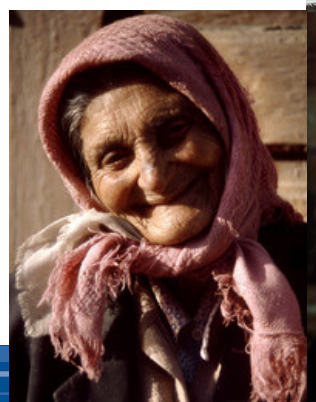
COMMON OCEANS

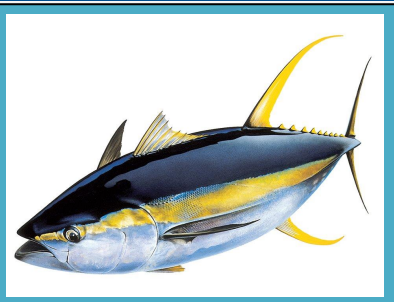
But we usually think much more strategically…

e.g. Where to go on vacation?

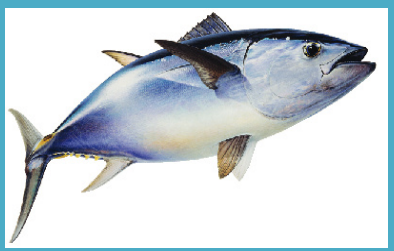


A compromise?
Nobody's favourite
But okay for all

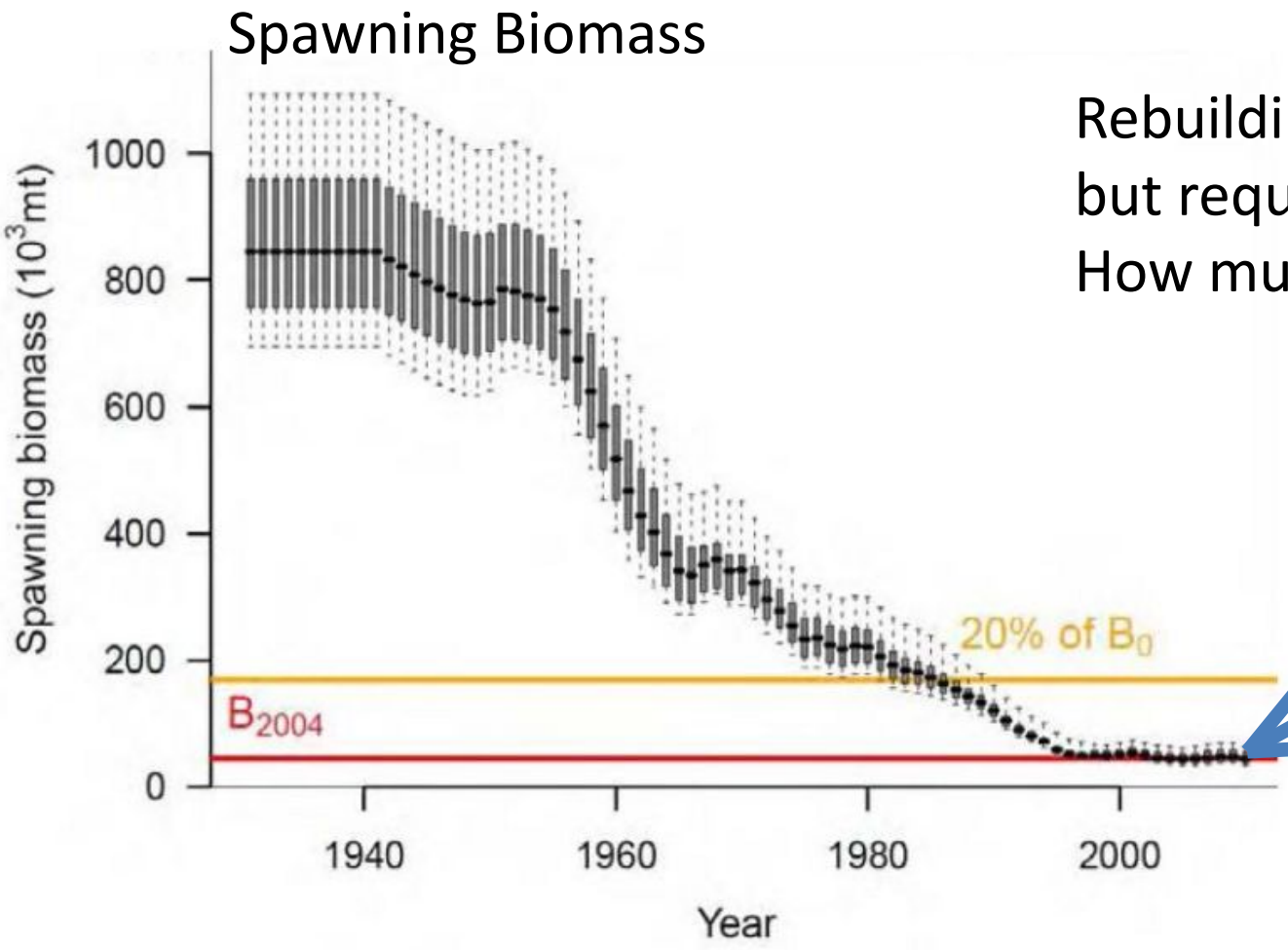




Fisheries Stakeholder Trade-offs: Where do you want to be?



Where do we want the fishery to be?



Rebuilding desired,
but requires catch reduction.
How much, how fast?

?

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Where do we want the fishery to be?

Management Objectives

- e.g. “…conservation and optimum utilisation of stocks…”

Performance Indicators

- Quantify management performance e.g.
  - Probability of achieving target
  - Staying within limit reference points

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Once we agree the destination, how to get there?

Random search?
Or Map & Compass?

Plan ahead for where you want your fishery to be

Invest in tools to get there

ON OCEANS

Harvest Strategy = the map and compass for the fishery

- Agreed procedure for collecting data, analysing the data and prescribing a management action
- Should learn from feedback and aim to achieve specific objectives

Doug Butterworth: "Agreeing the rules of the game before it is played"

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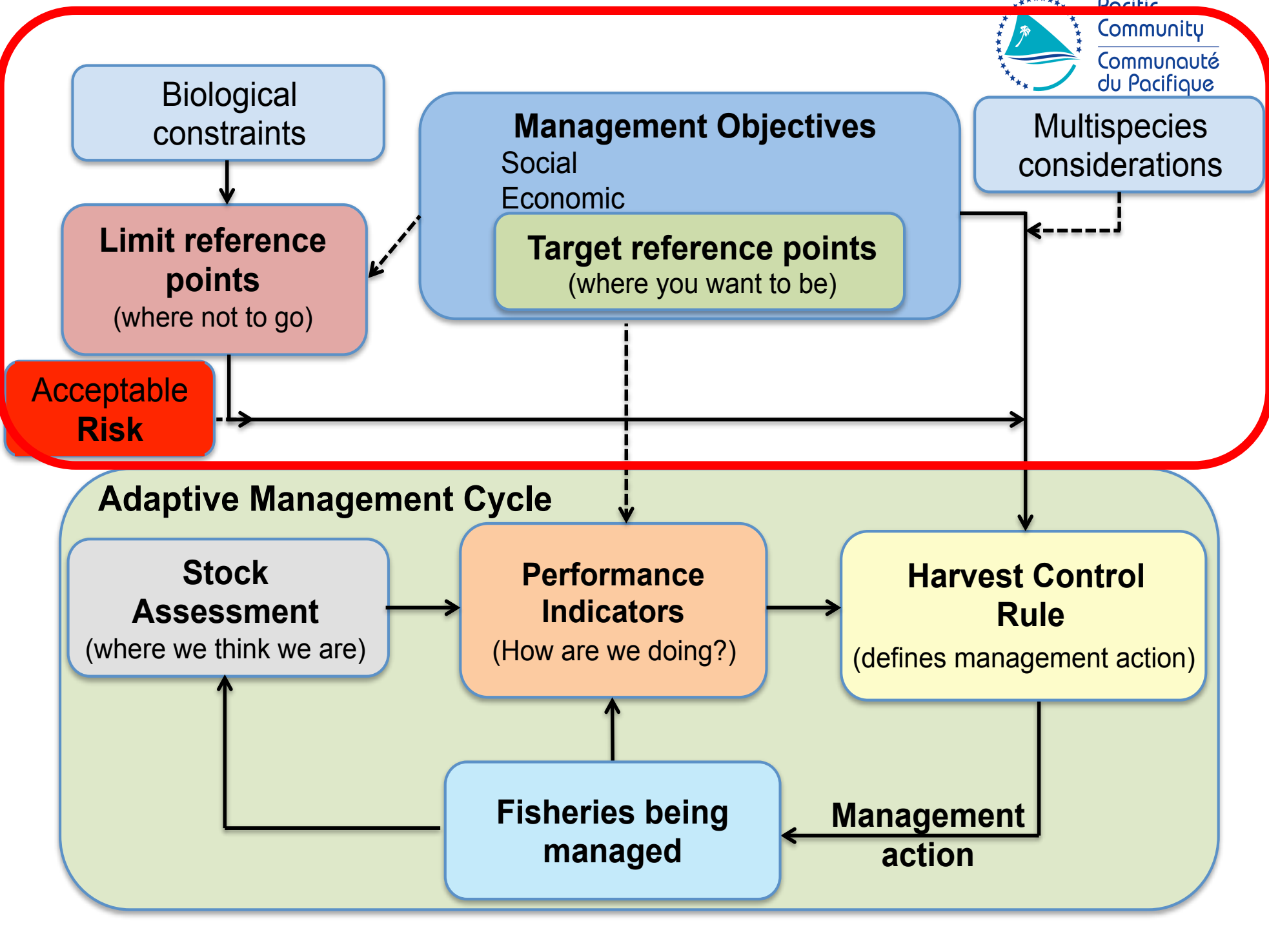
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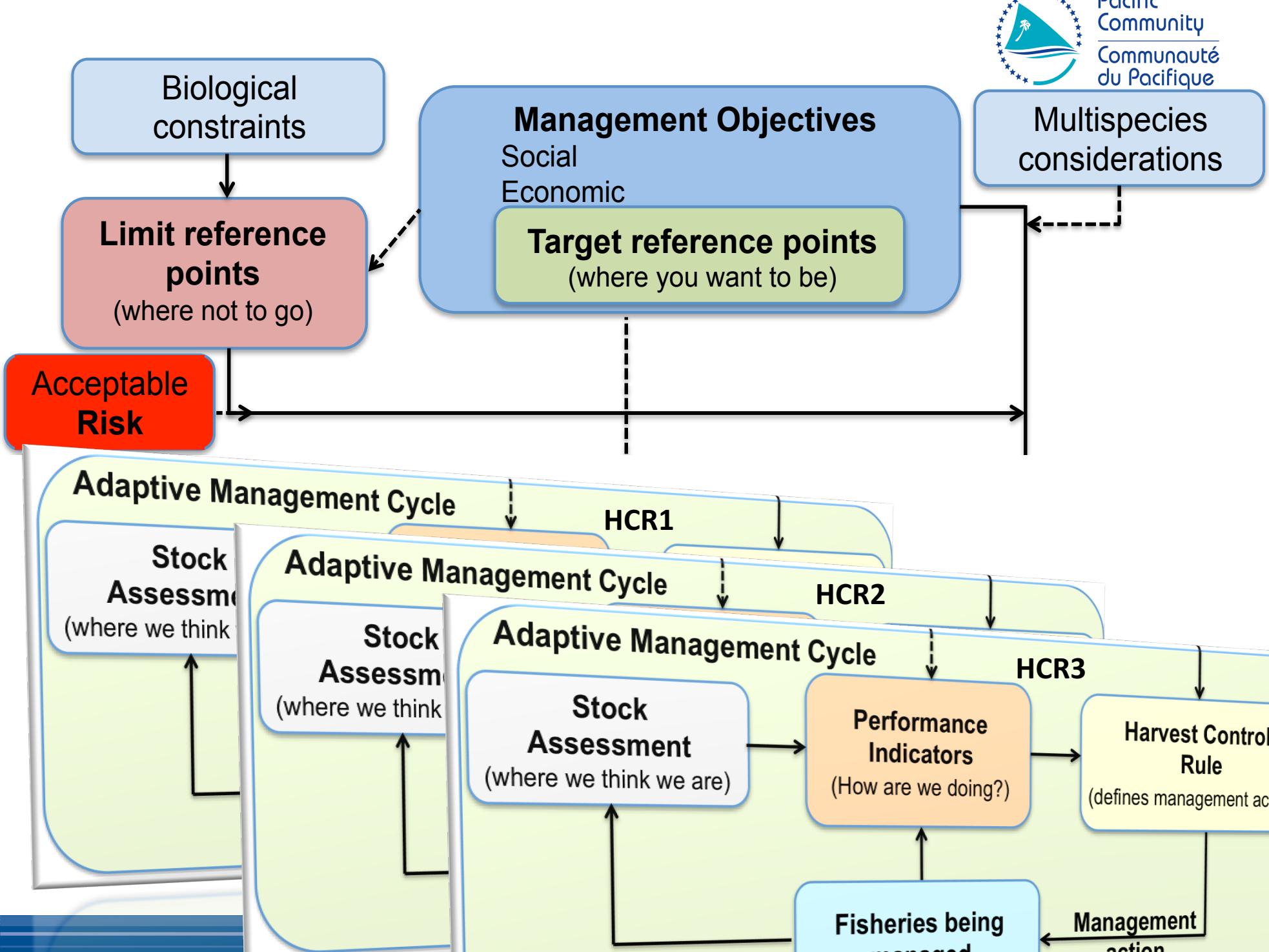
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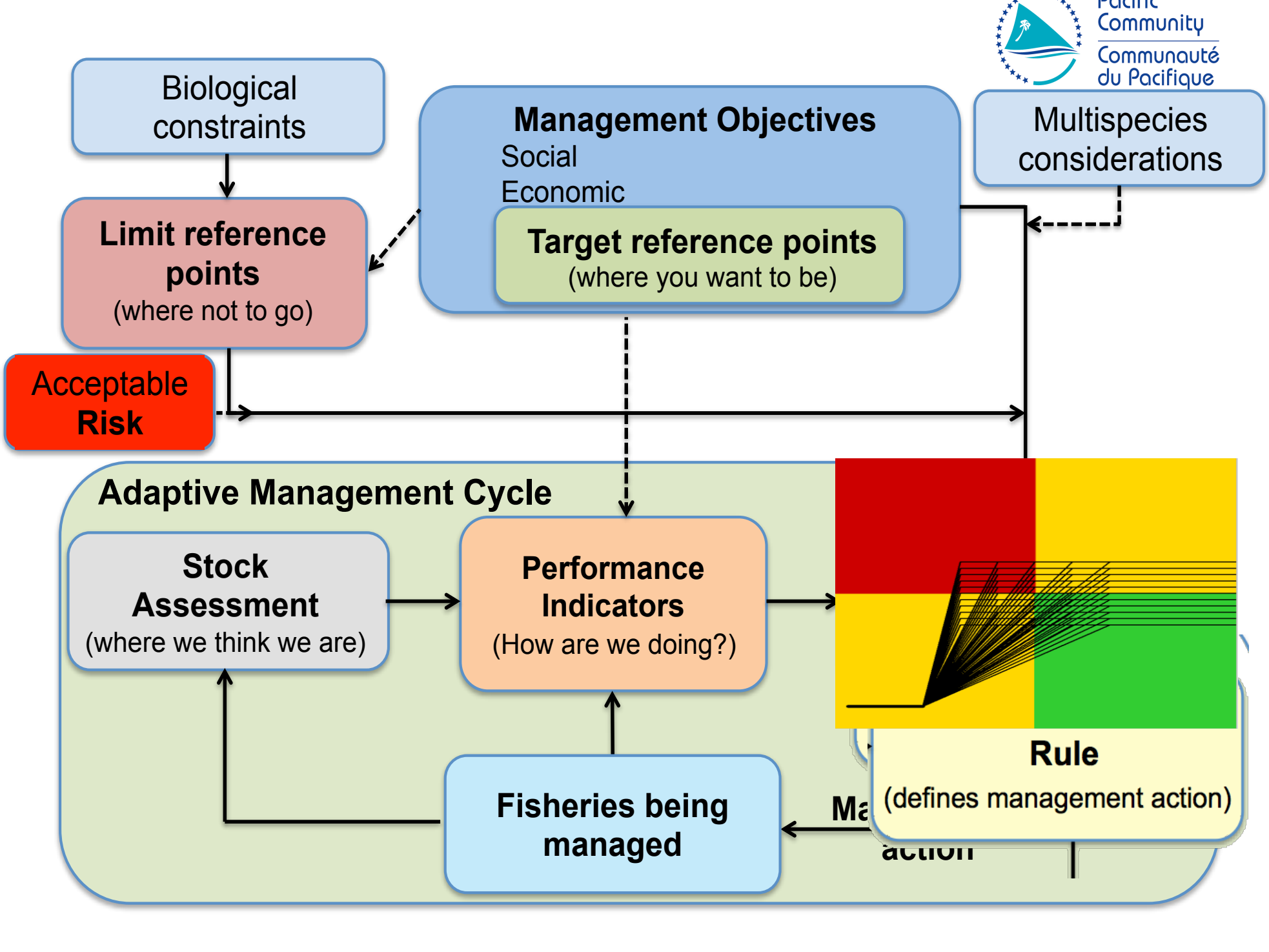
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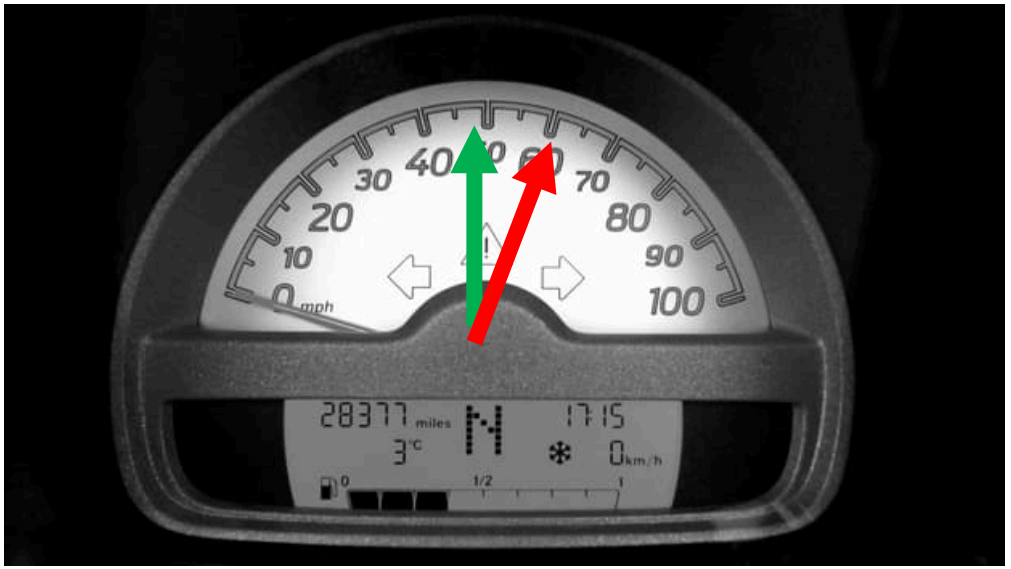
Rule
(defines management action)
Fisheries being managed

Target Speed = 50km/h Speed Limit = 60km/h

Data



Decision Rule

If Speed ~ 50km/h

keep the status quo

If Speed < 40 km/h:

You'll be late !

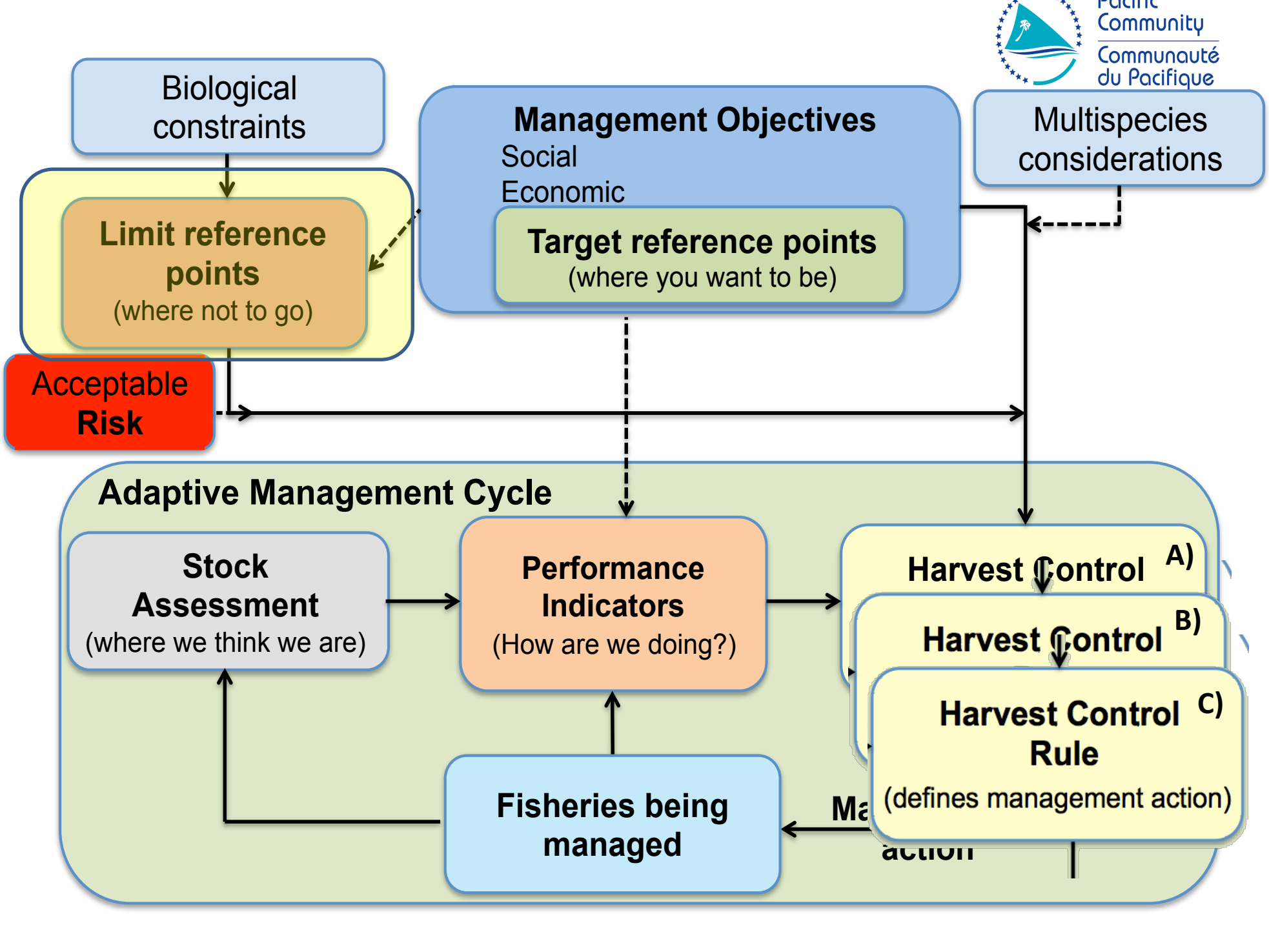
Step on the accelerator

If Speed > 60 km/h

You'll get a ticket (and risk crash)!

Step off the accelerator

COMMON OCEANS

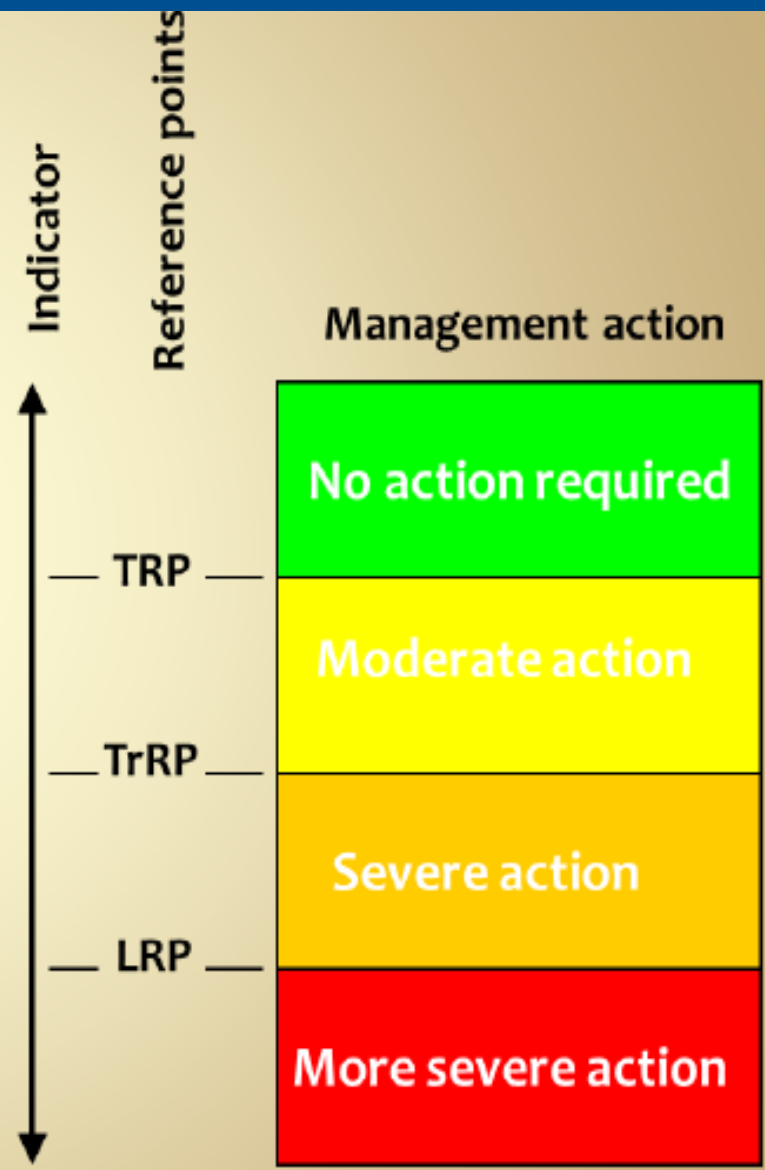

Pacific Community
Communauté du Pacifique
Biological constraints
Management Objectives
Social
Economic
Target reference points
(where you want to be)
Multispecies considerations
Limit reference points
(where not to go)
Acceptable Risk
Adaptive Management Cycle
Stock Assessment
(where we think we are)
Performance Indicators
(How are we doing?)
Harvest Control A)
Harvest Control B)
Harvest Control Rule C)
(defines management action)
Fisheries being managed

- RPs are guidelines for management; can be:
  - exploitation rates or biomass based;
  - model or empirical based

- **Target Reference Points** (TRPs): values for stock size and/or fishing mortality rate that a manager aims to **achieve and maintain.**

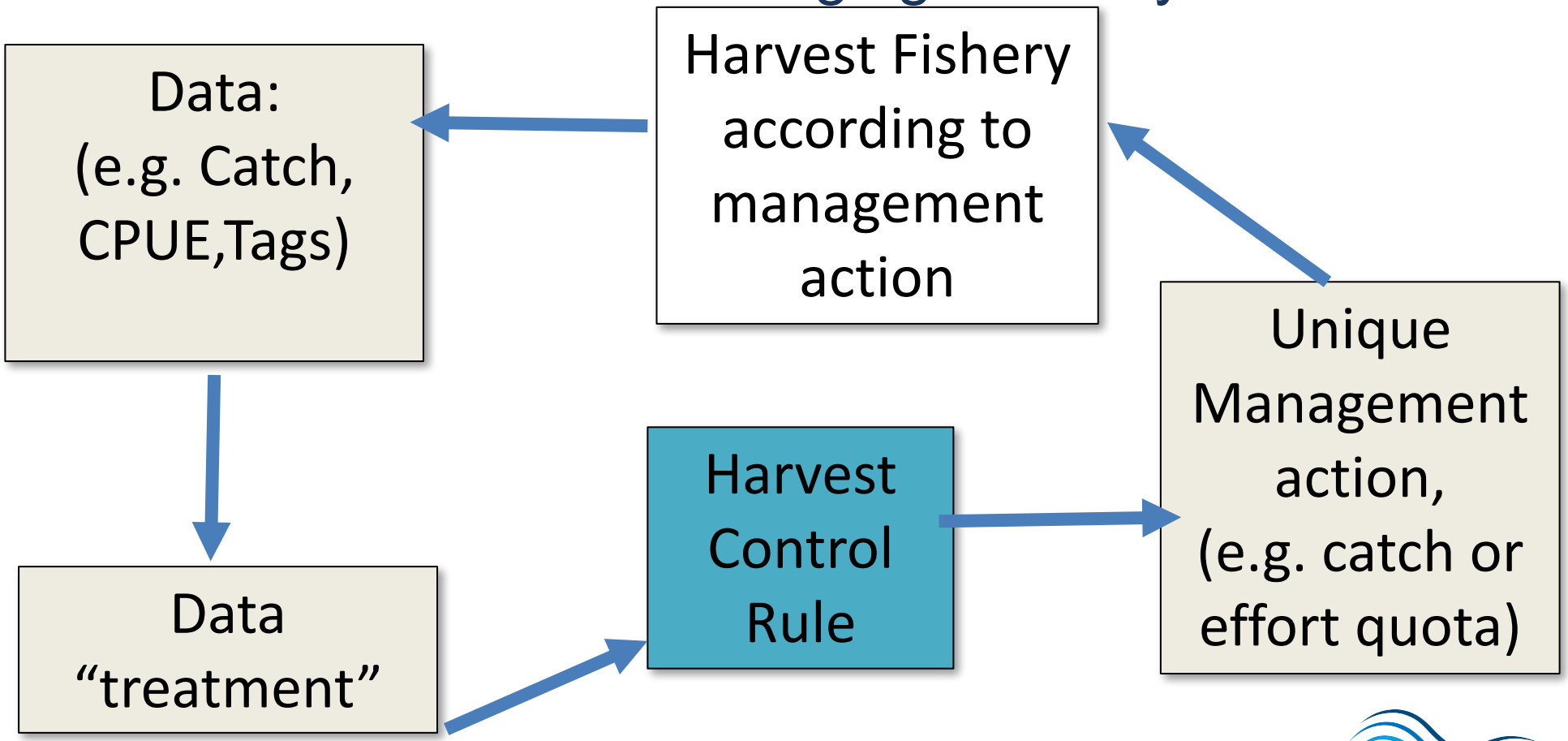
- **Threshold Reference Points** (TrRPs), which identify a predefined management response.

- **Limit Reference Points** (LRPs), which describe an undesirable state of the indicator that should be **avoided** with high probability.



Harvest Control Rule

- A decision rule for managing a fishery



COMMON OCEANS

Types of Harvest Control Rules

Constant Catch (or effort)

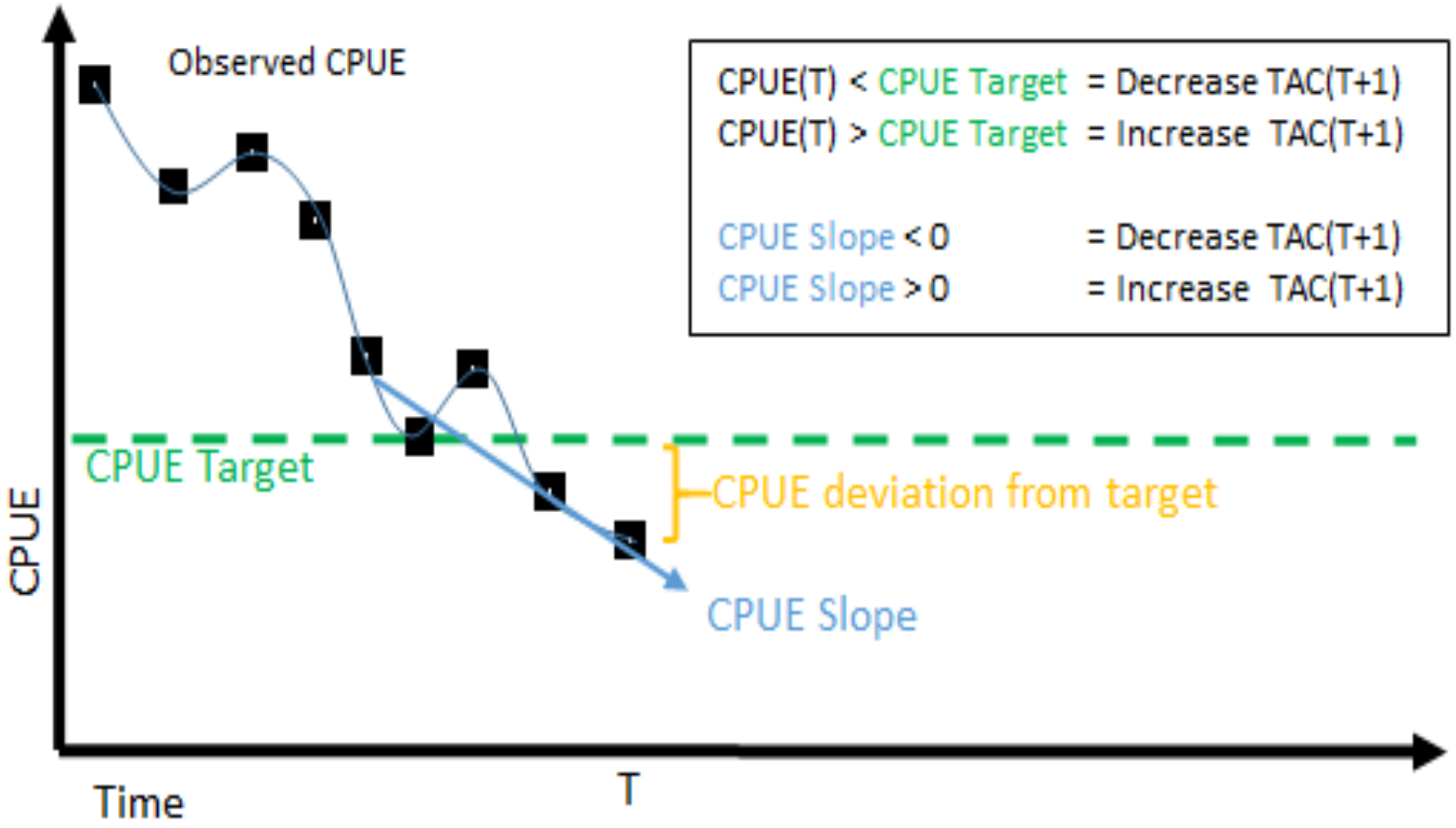
Empirical treatment
Minimal data manipulation
Care required to minimize responses to “noisey” data

Model-based
Typically simplified
Enhanced **transparency**

COMMON OCEANS

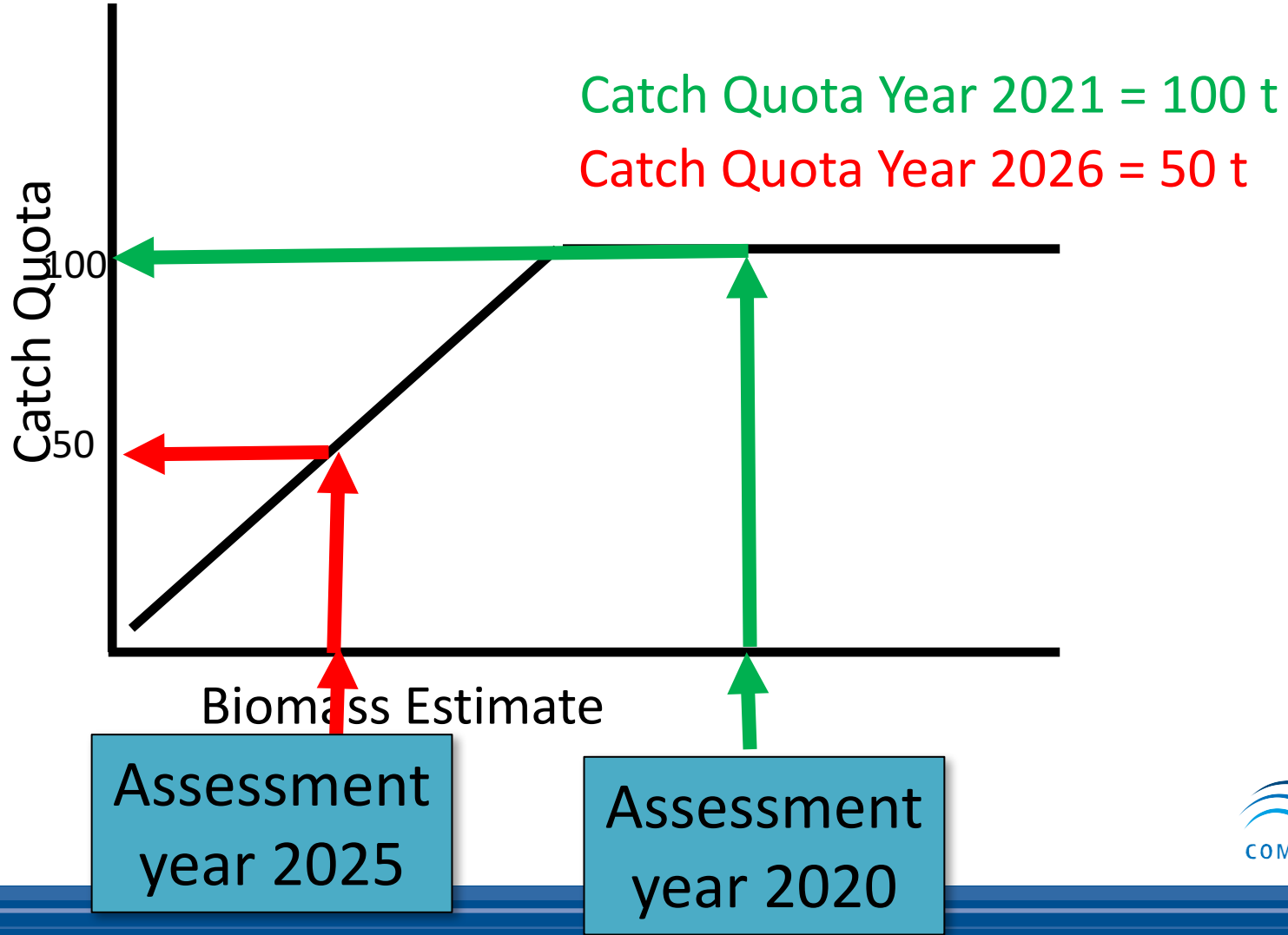
Empirical – only uses CPUE data as abundance index

TAC = Total Allowable Catch



A Model-Based Harvest Control Rule example:

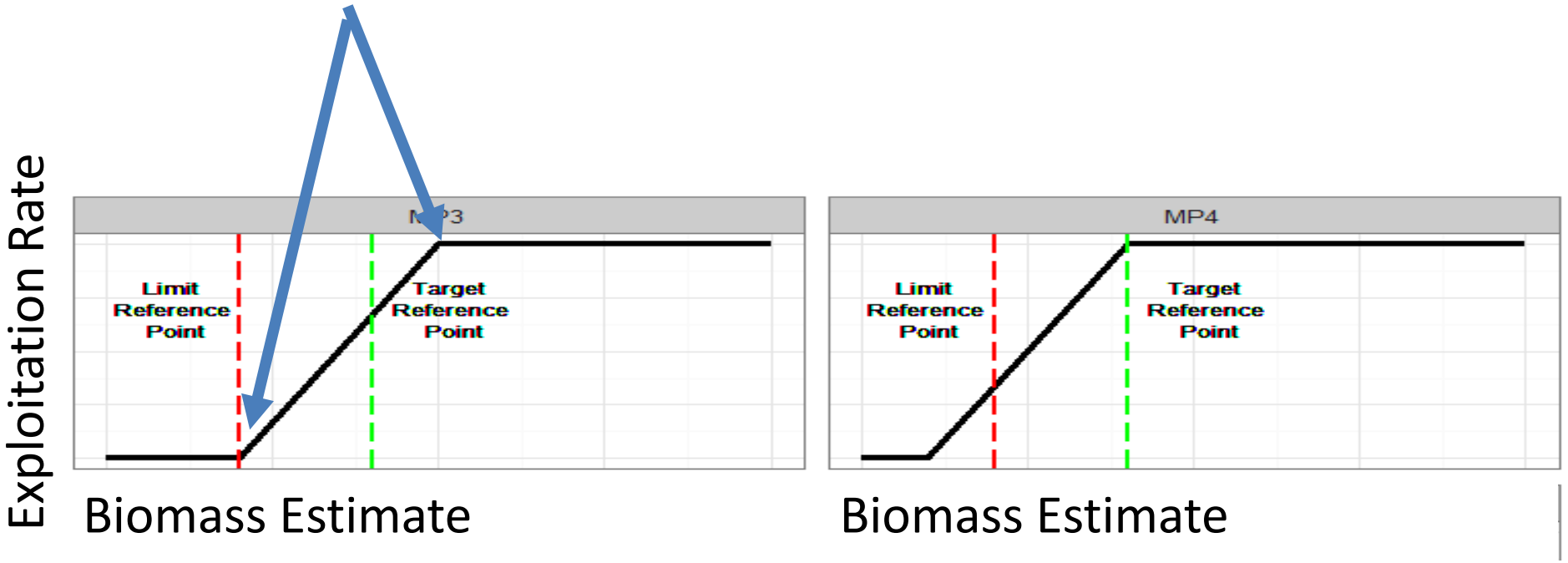
1) Fit a pre-defined assessment model
2) Use the HCR to set the catch limit



COMMON OCEANS

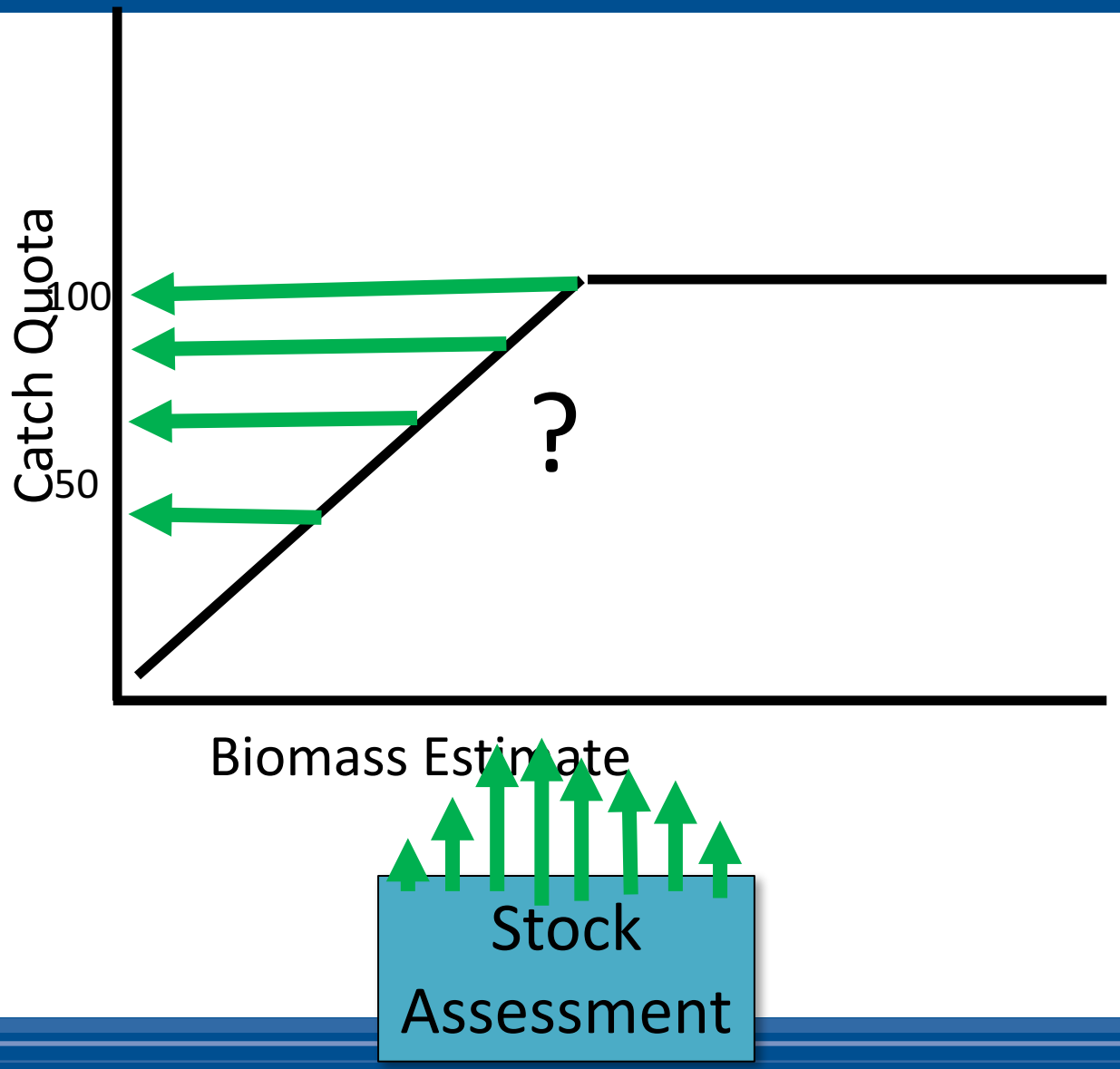
Model-Based Harvest Control Rule

Control parameters (sometimes called threshold ref points)



- HCRs can have arbitrary controls
- Formal “Reference points” used to evaluate performance of HCR (but don’t have to be part of the HCR…)

What about assessment uncertainty?



COMMON OCEANS

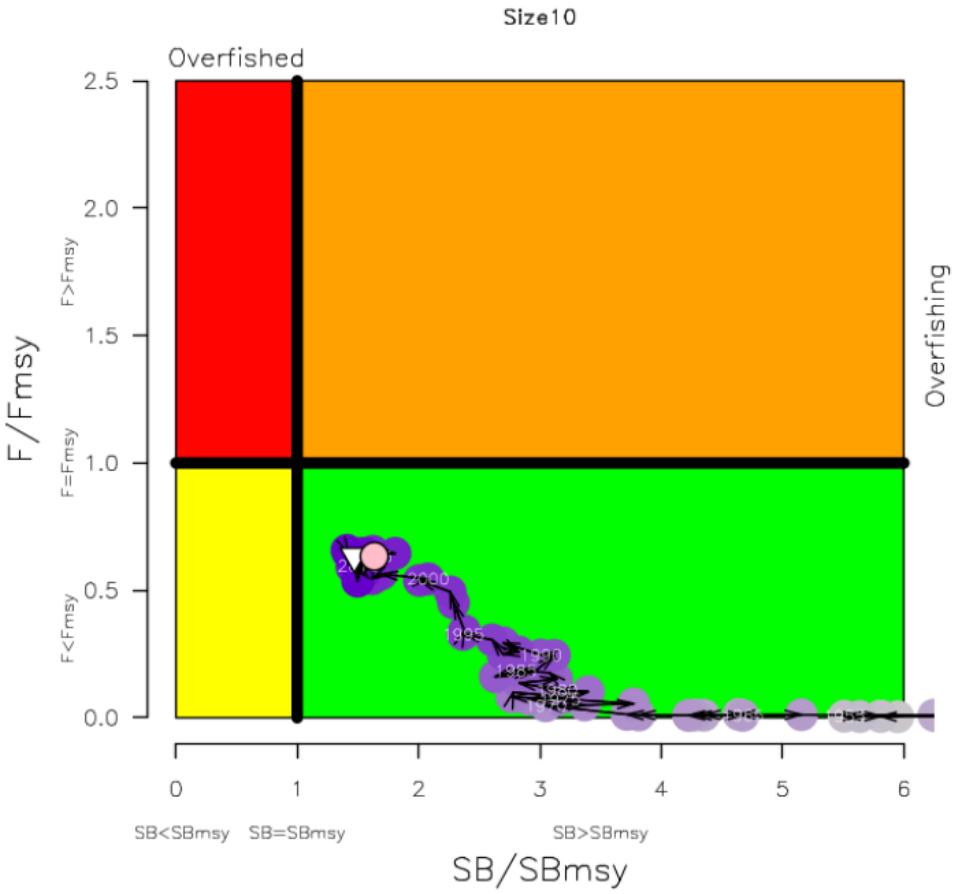
Slow down in poor visibility

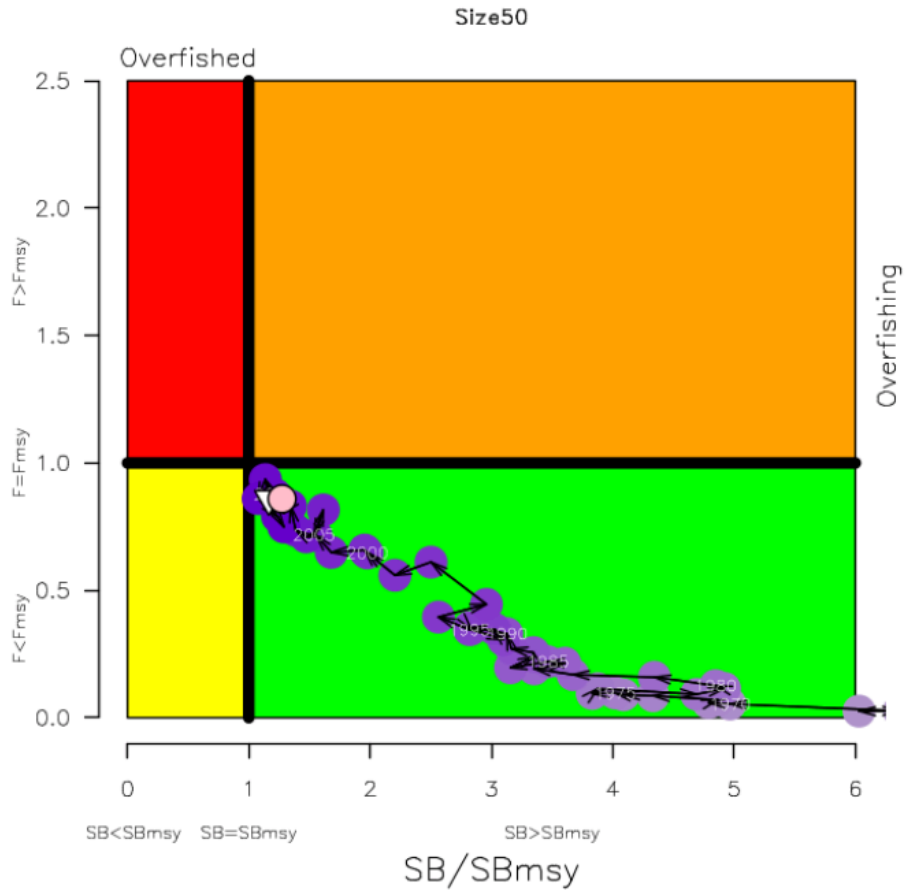
Be more careful with multiple hazards

Invest in better lights, tires & airbags

Catch fewer fish and build fewer boats if you are more uncertain about the fish stock status and productivity;
Invest in better data

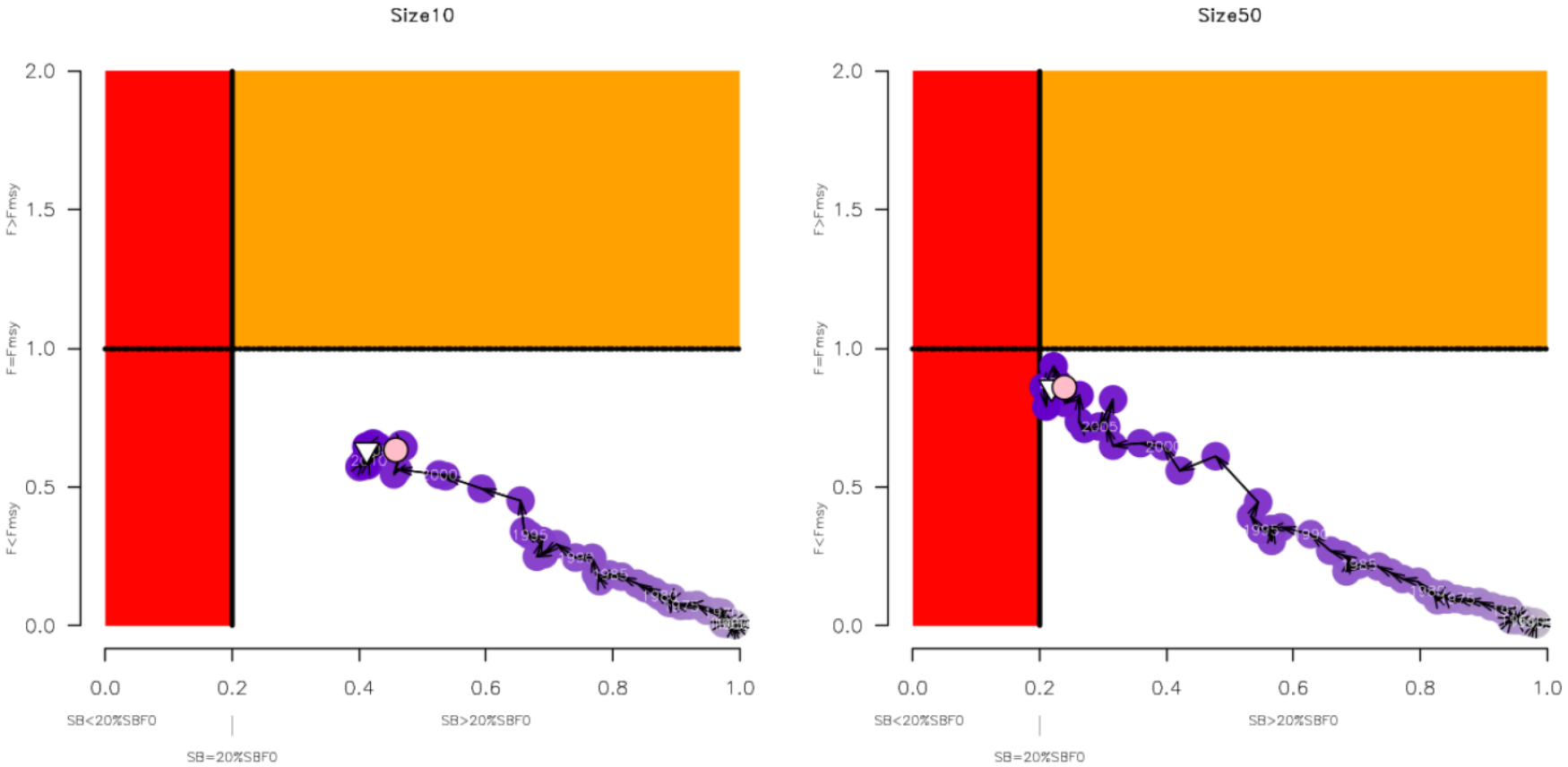
Example “Kobe plot”





COMMON OCEANS

Example “Majuro plot”



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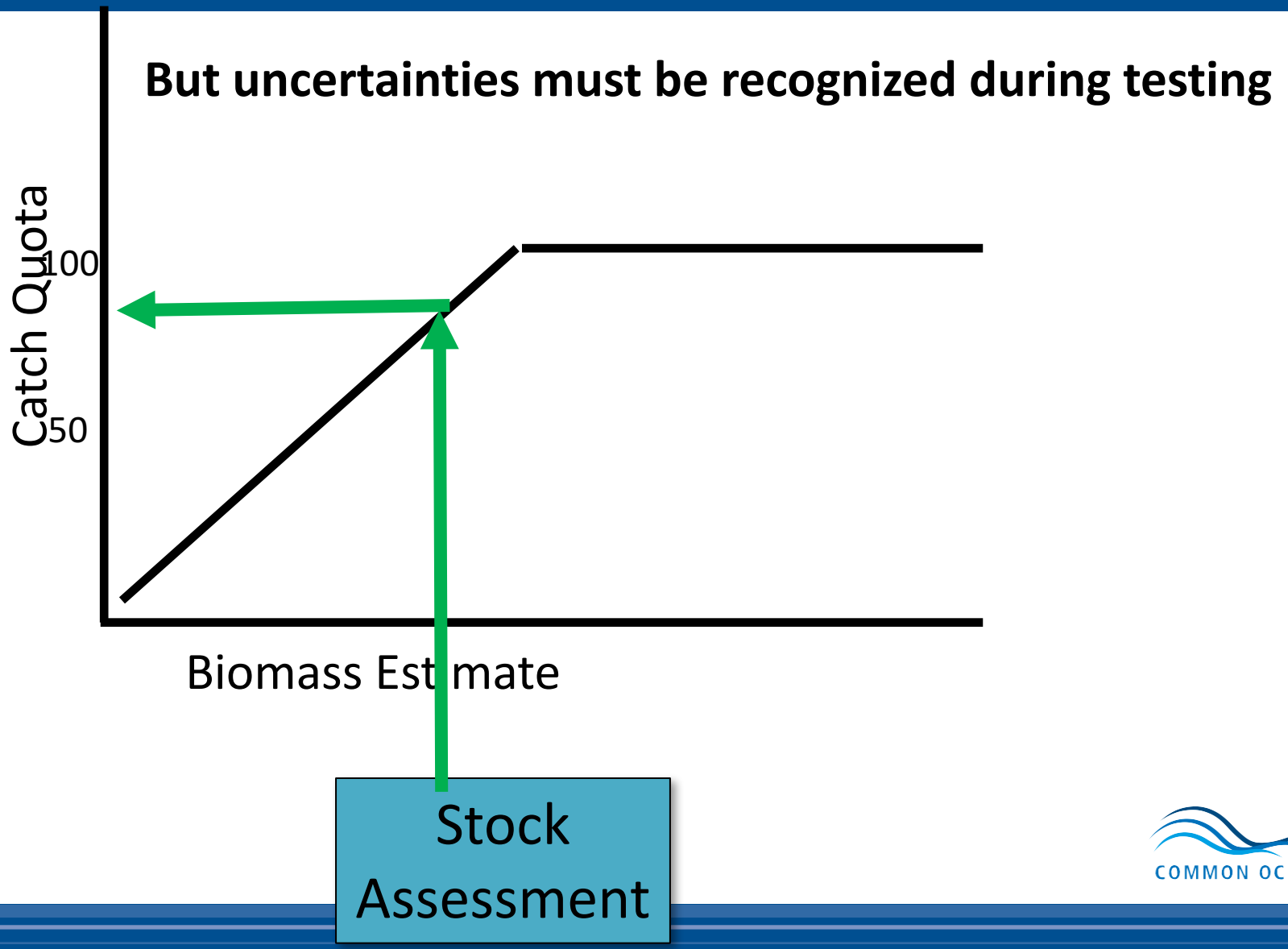
Harvest Control Rule must provide a unique recommendation



COMMON OCEANS

Driving Simulator Analogy

- Practice
- Prepare for rare and unexpected situations
- Learn from mistakes without irreversible consequences

Use Fishery Simulator for Management Strategy Evaluation

What is Management Strategy Evaluation?

- A computer simulation strategic risk assessment tool
- Evaluation of alternative harvest strategies under range of plausible uncertainties (e.g. current stock status, future productivity, data errors)
- Selection of harvest strategies that are most likely to meet management objectives and be “robust” to major uncertainties

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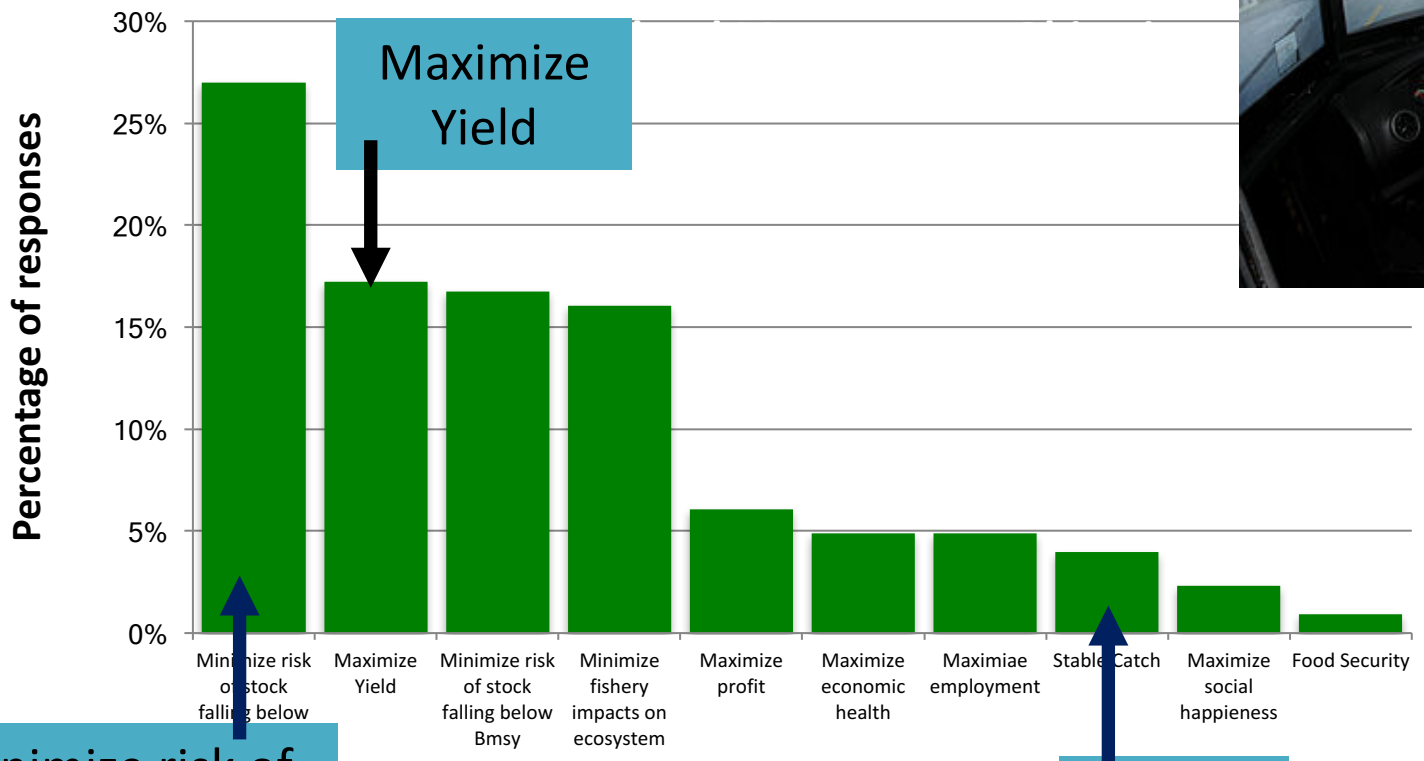
Differing Management Objectives ➔Trade offs

E.g., survey results from workshop



Minimize risk of stock falling below B(limit)

Stable Catch

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Ideal Management Strategy Evaluation Process:

1. Identification of management objectives and performance measures

2. Development of simulation models for data generation

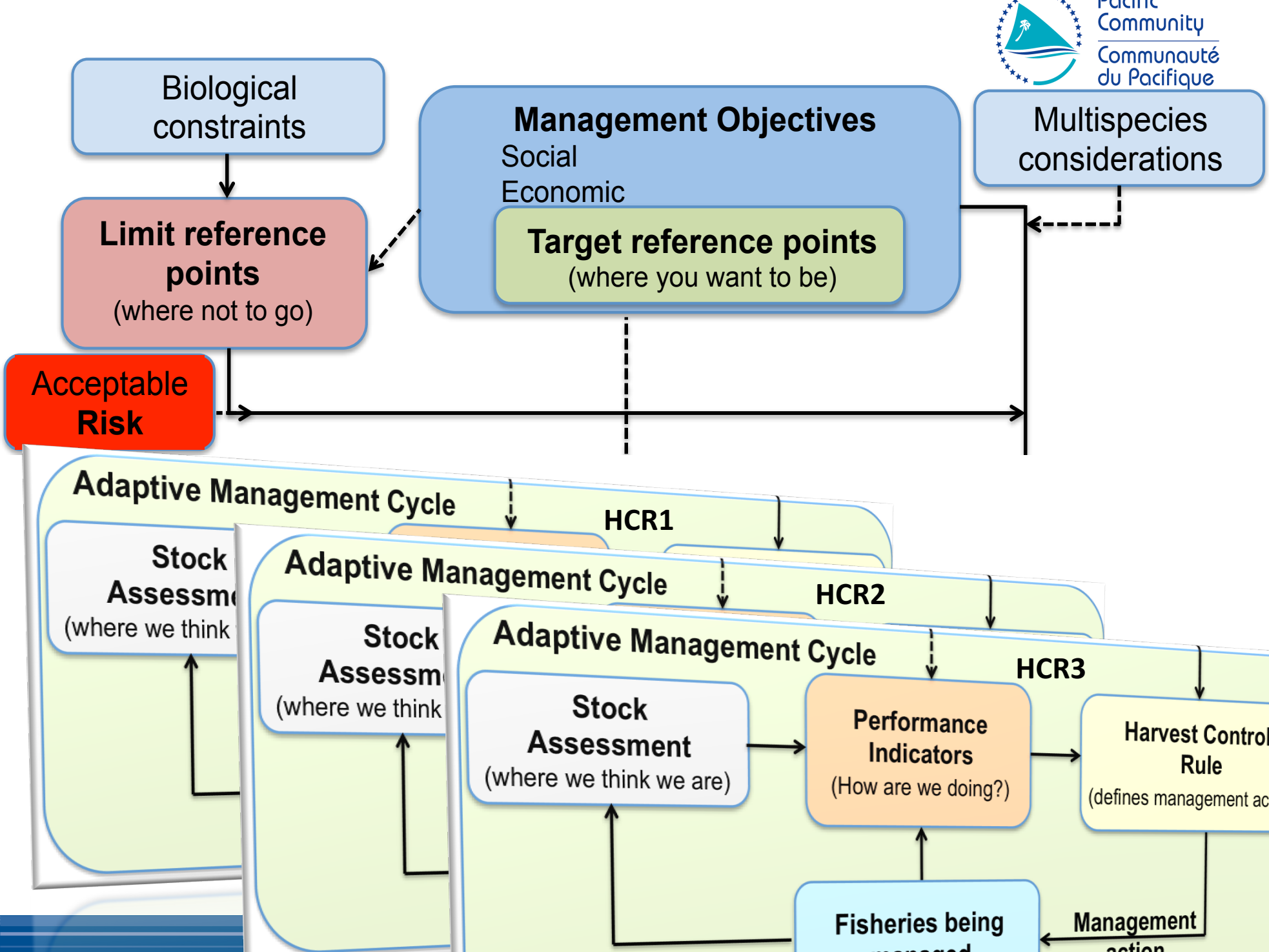
3. Development of candidate harvest strategy (given data)

4. Test candidates

5. Select “best” candidate

6. Implementation (subject to future performance review)

COMMON OCEANS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HCR1
Stock Assessm
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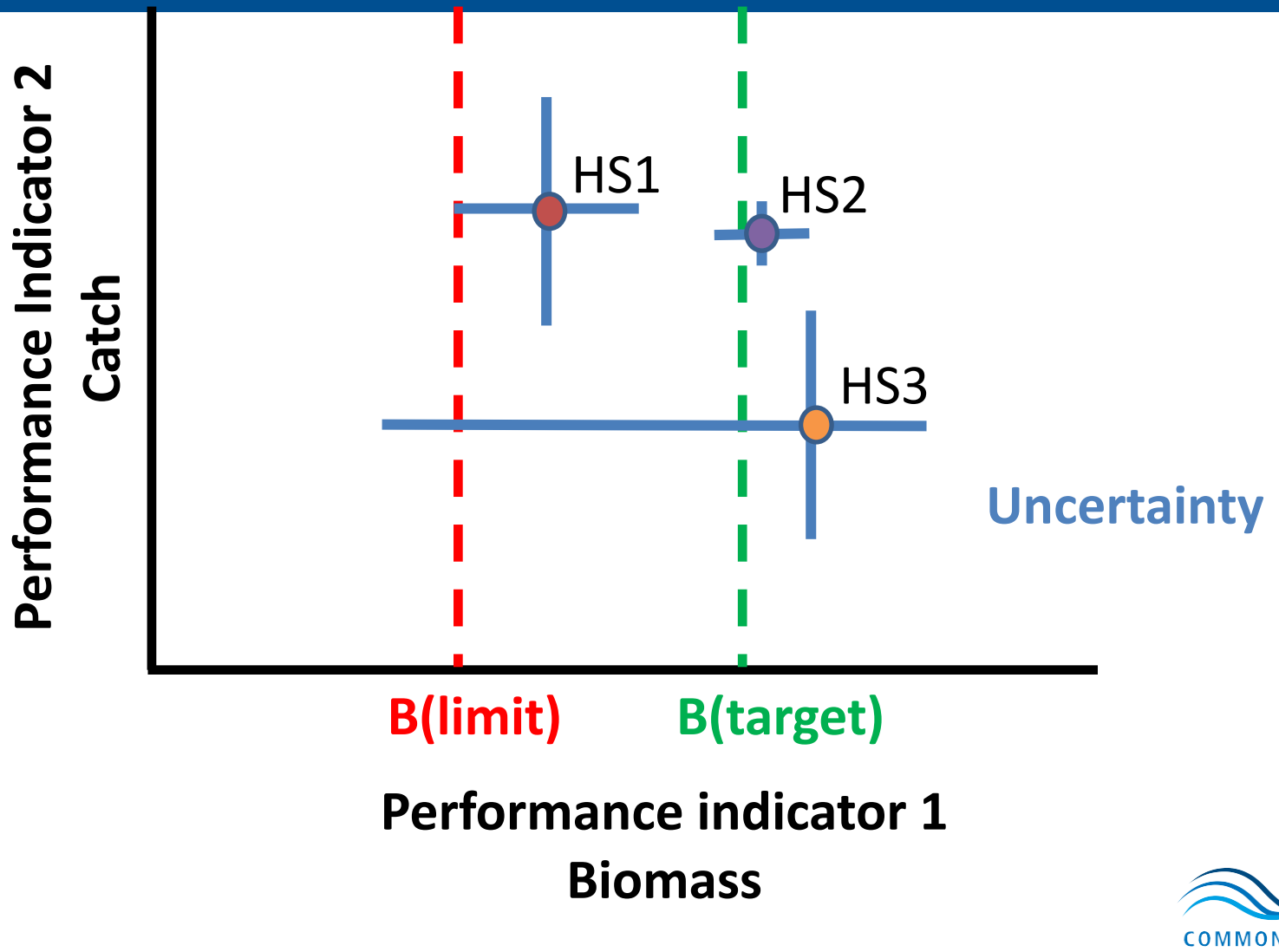
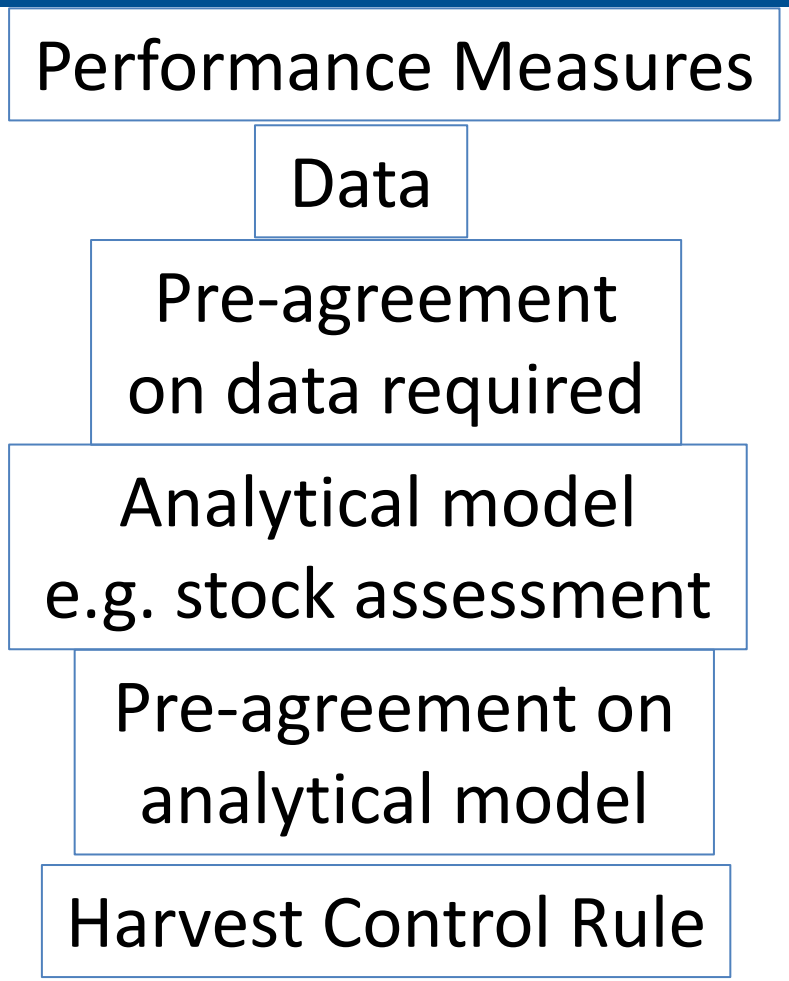
Adaptive Management Cycle
HCR2
Stock Assessm
(where we think
Adaptive Management Cycle
HCR3
Stock Assessment
(where we think we are)
Performance Indicators
(How are we doing?)
Harvest Control Rule
(defines management ac
Fisheries being
Management

Selection of harvest strategy
Trade-off plot of simulation results
(e.g. average over next 10 years)



COMMON OCEANS



COMMON OCEANS

Key Summary Points

1. For our purposes- Harvest Strategy = Management Procedure: Pre-agreed data and simulation-tested algorithm for specifying a management action

2. Adopting a Harvest Strategy has many advantages over traditional assessment and management

- Transparency in decision making
- Robust to uncertainties

3. Management Strategy Evaluation – Using computer simulations to evaluate harvest strategies

- MSE is an interactive process ideally involving managers, scientists, industry, NGOs
- Explicit evaluation of harvest strategy with respect to objectives as quantified by performance indicators

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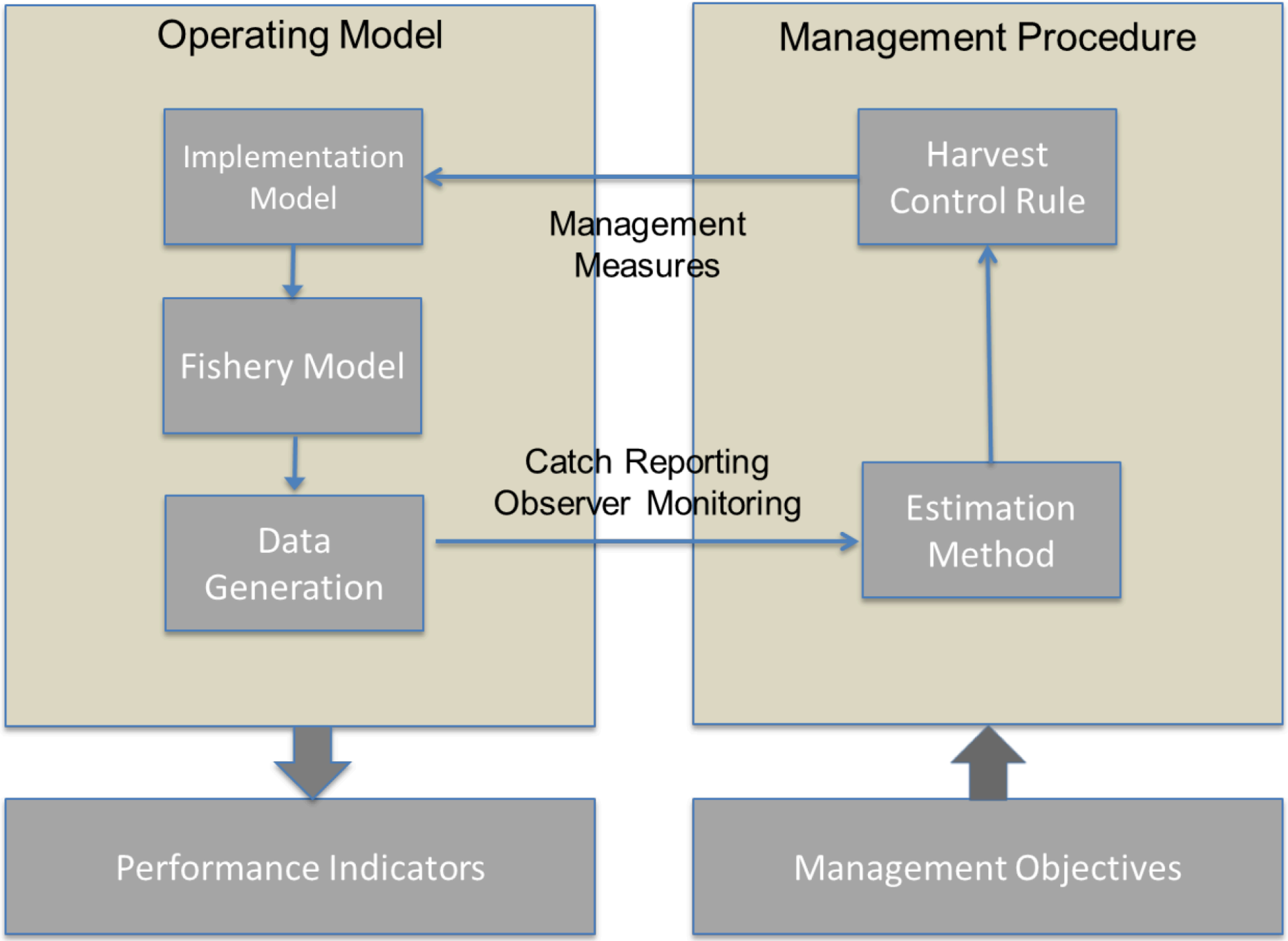
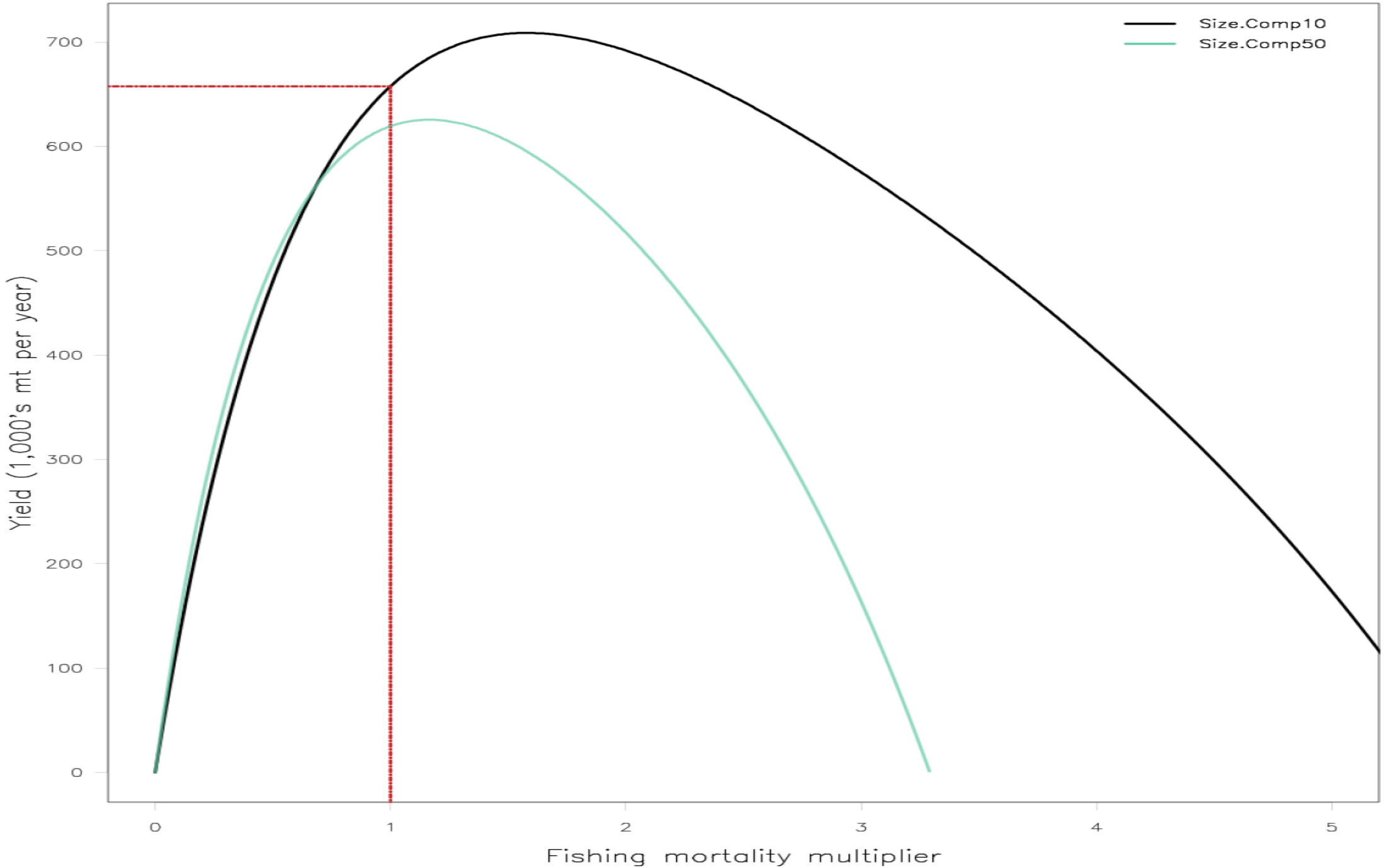
Agreed 2016 work plan for the adoption of harvest strategies under CMM 2014-06

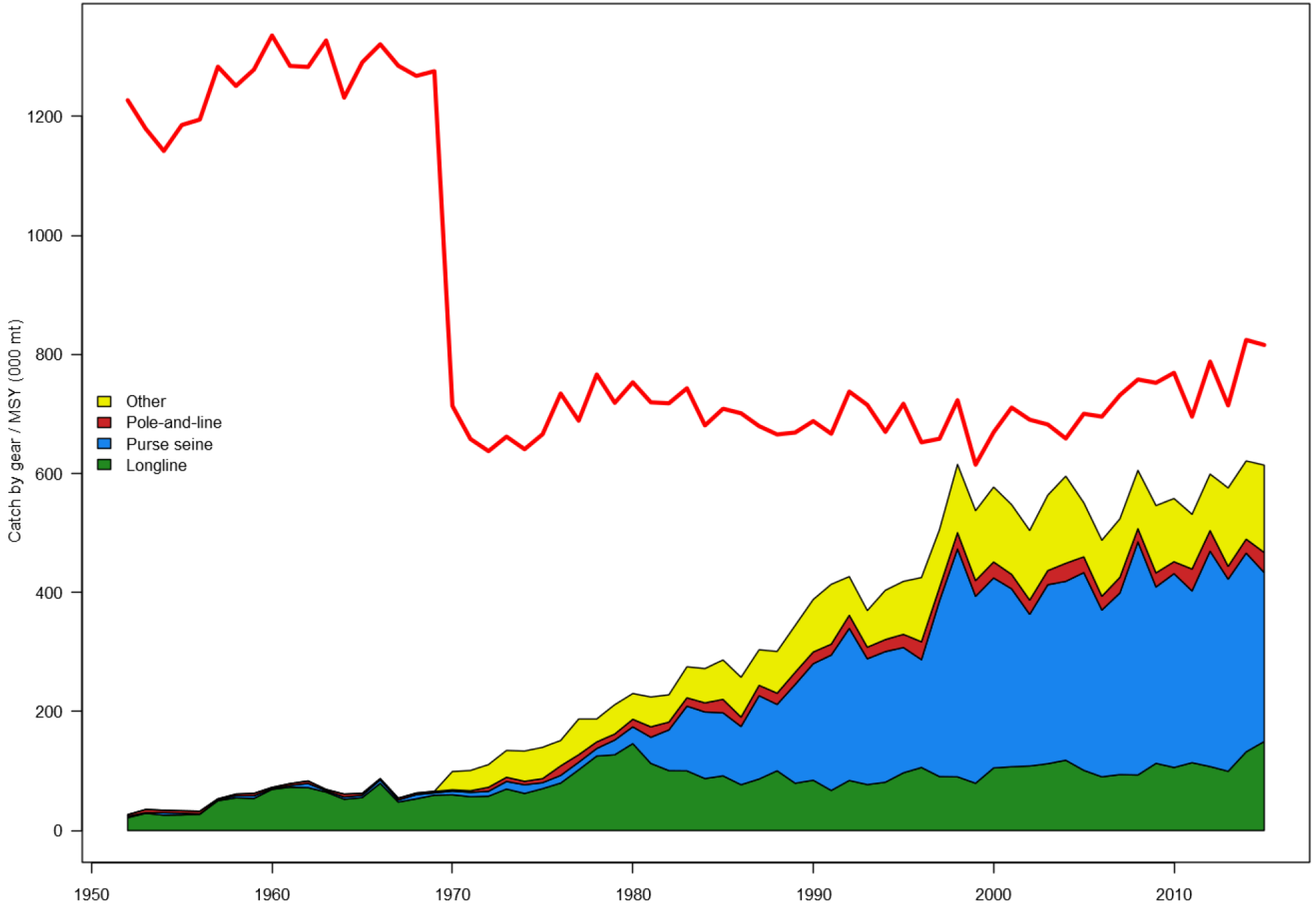
	South Pacific Albacore	Skipjack	Bigeye	Yellowfin
2016	Scientific Committee • SC provide advice on implications of a range of Target Reference Points for south Pacific albacore. • SC provide advice on a monitoring strategy to assess performance against reference points. • SC provide advice on a range of performance indicators to evaluate performance of harvest control rules. Commission • Commission record management objectives for south Pacific albacore noting advice provided by the SC on a range of target reference points. • Commission agree to acceptable levels of risk for breaching Limit Reference Point for south pacific albacore. • Commission agree a Target Reference Point for south pacific albacore. • Commission agree to a monitoring strategy to assess performance against reference points. • Commission agree performance indicators to evaluate harvest control rules • Management strategy evaluation	Scientific Committee • SC provide advice on a monitoring strategy to assess performance against reference points. • SC provide advice on a range of performance indicators to evaluate performance of harvest control rules. Commission • Commission record management objectives for skipjack noting advice provided by the SC on a range of target reference points. • Commission agree to acceptable levels of risk for breaching Limit Reference Point for skipjack. • Commission agree to a monitoring strategy to assess performance against reference points. • Commission agree performance indicators to evaluate harvest control rules • Management strategy evaluation	Scientific Committee • Commission task SC to determine a biologically reasonable timeframe for rebuilding bigeye tuna to [or above] its limit reference point. Commission • Commission agree timeframes to rebuild stock to LRP • Commission agree acceptable levels of risk for breaching Limit Reference Point for bigeye tuna. • Commission record management objectives for bigeye and ask SC for advice on a range of target reference points.	Commission • Commission agree to acceptable levels of risk for breaching Limit Reference Point for yellowfin tuna. • Commission record management objectives for yellowfin and ask SC for advice on a range of target reference points.

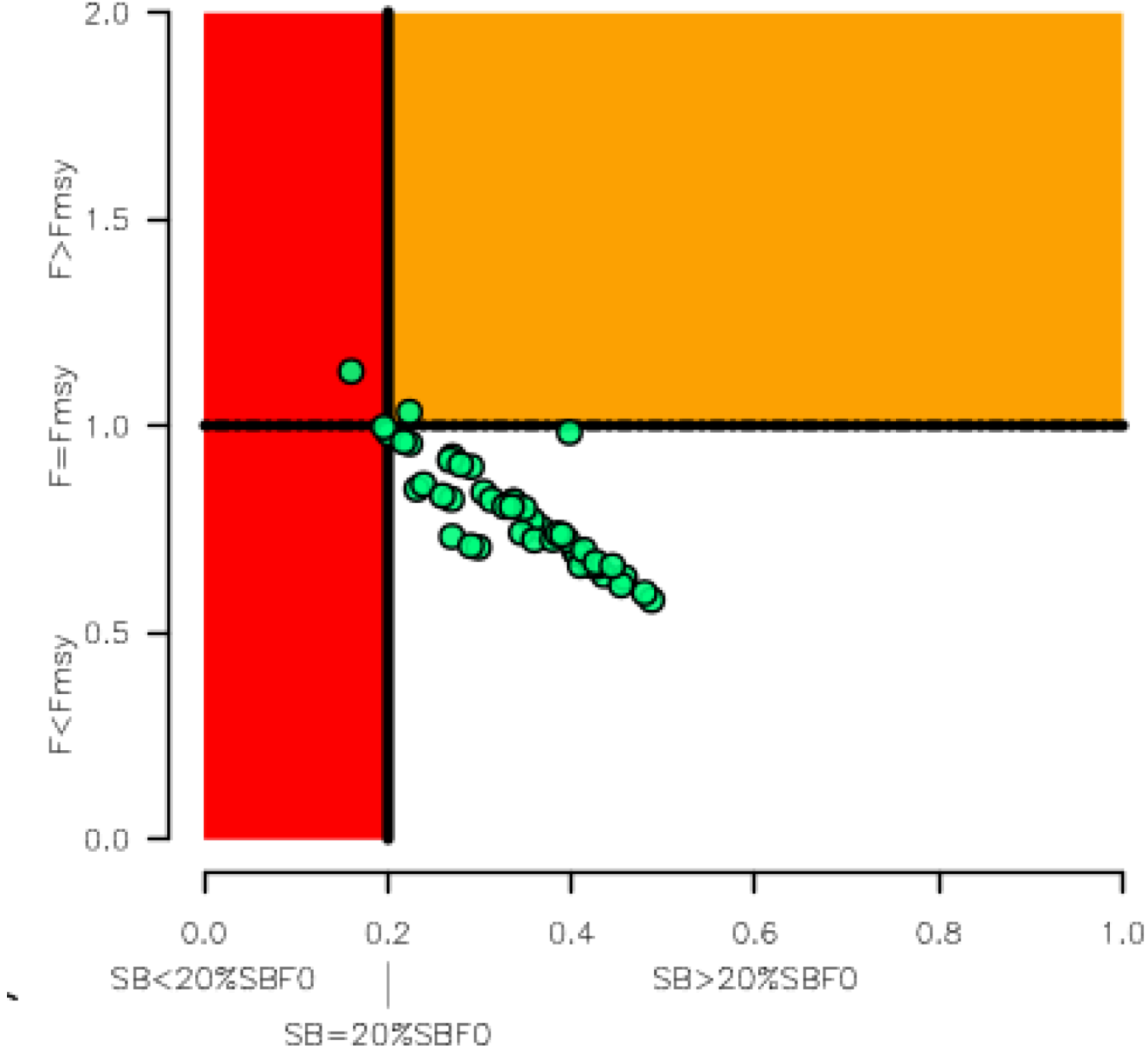
Thank you!

MSE Scheme


Operating Model
Management Procedure
Implementation Model
Harvest Control Rule
Management Measures
Fishery Model
Catch Reporting
Observer Monitoring
Data Generation
Estimation Method
Performance Indicators
Management Objectives


Size.Comp10
Size.Comp50
Yield (1,000's mt per year)
700
600
500
400
300
200
100
0
0
1
2
3
4
5
Fishing mortality multiplier


Catch by gear / MSY (000 mt)
0
200
400
600
800
1000
1200
1950
1960
1970
1980
1990
2000
2010
Other
Pole-and-line
Purse seine
Longline


2.0
1.5
1.0
0.5
0.0
F>Fmsy
F=Fmsy
F<Fmsy
0.0
0.2
0.4
0.6
0.8
1.0
SB<20%SBF0
SB=20%SBF0
SB>20%SBF0

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WESTERN & CENTRAL PACIFIC OCEAN TUNA MANAGEMENT WORKSHOP

BALI, INDONESIA | 1ST - 2ND AUGUST 2017

Case Study: South Pacific Albacore

KEMENTERIAN KELAUTAN DAN PERIKANAN

FAO FIAT PANIS

gef

ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

WWF

SUPPORTED BY:

OCEAN OUTCOMES

SP Albacore: Harvest Strategy Elements

Management Objectives ✓

Limit Reference Point ✓

Target Reference Point

Performance Indicators

Acceptable Levels of Risk

Preliminary work ongoing

Harvest Control Rule ✗

Management Strategy Evaluation

COMMON OCEANS

SP Albacore: Management Objectives

Biological	Maintain albacore (and SWO, YFT & BET) biomass at or above levels that provide stock sustainability throughout their range.
Economic	Maximise economic yield from the fishery.
	Maximise catch
	Maintain acceptable CPUE.
	Maximise SIDS revenues from resource rents.
	Catch stability.
	Effort predictability
	Maintain ALB, BET, YFT, SWO stock sizes around the TRP (where adopted)
Social	Food security in developing states (import replacement)
	Avoid adverse impacts on small scale fishers.
Ecosystem	Minimise catch of non-target species.

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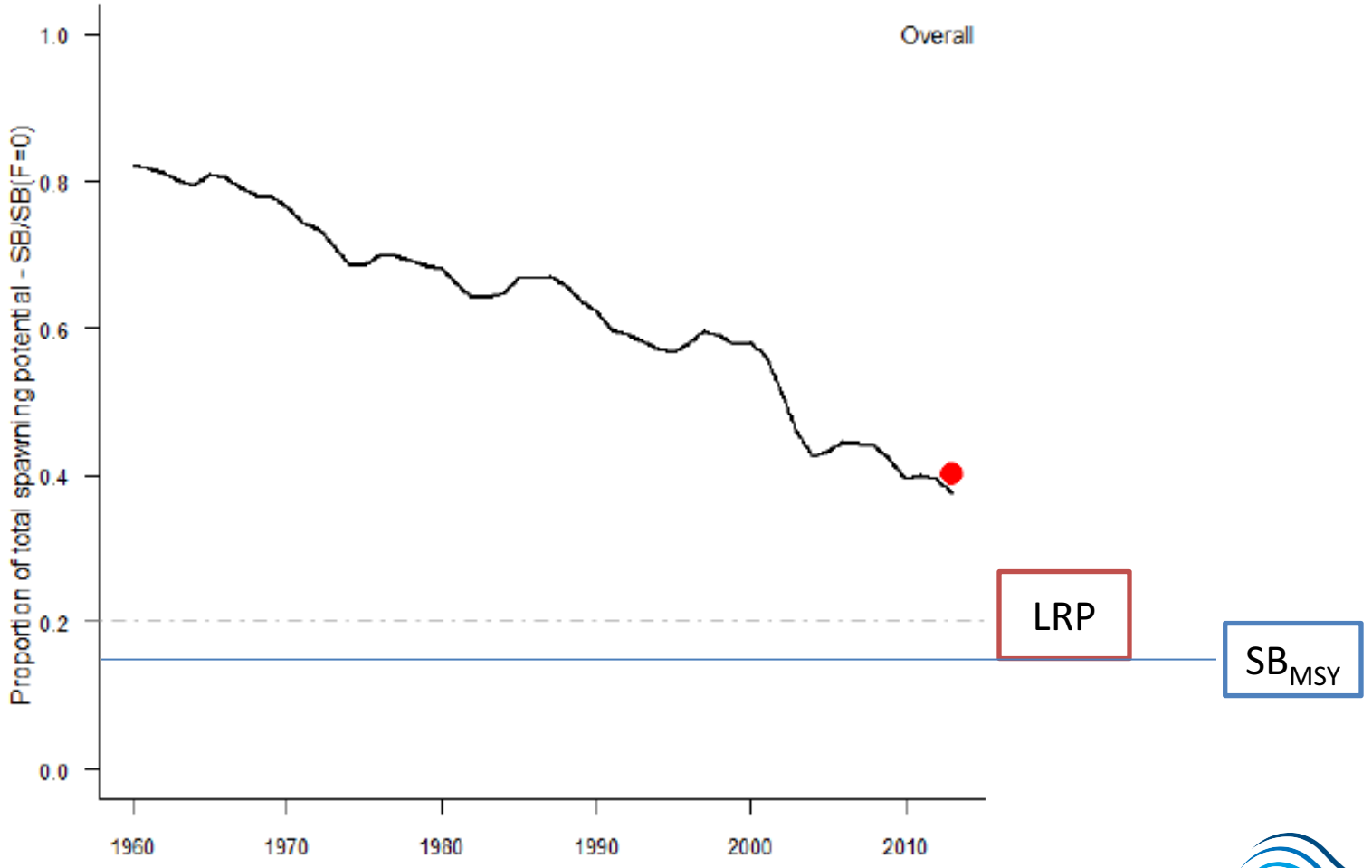
SP Albacore – Biological objectives



SC11-SA-WP-06 Figure 37 Unexploited spawning potential for the ref case

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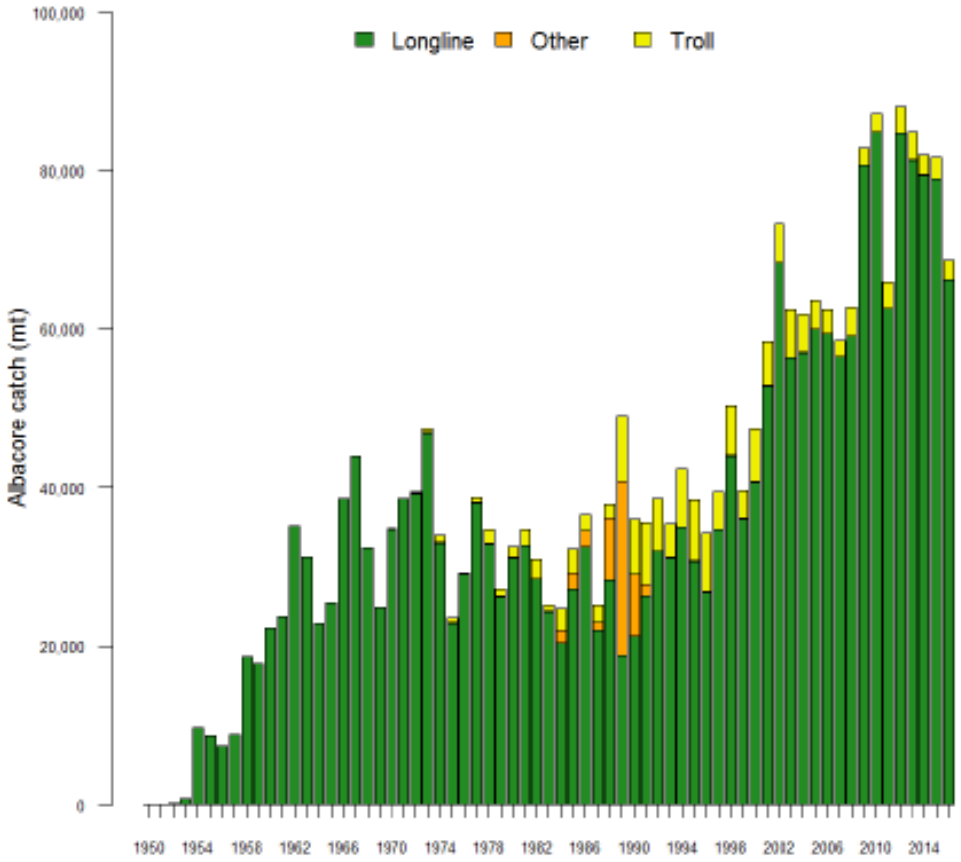
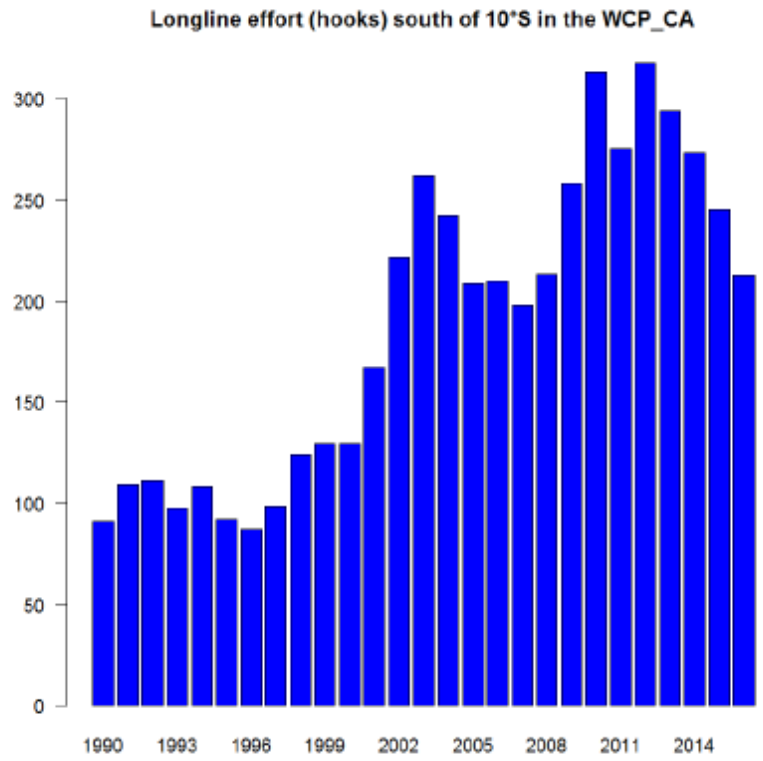
SP Albacore – Economic objectives





SC13-SA-WP-08 Figures 1 & 3

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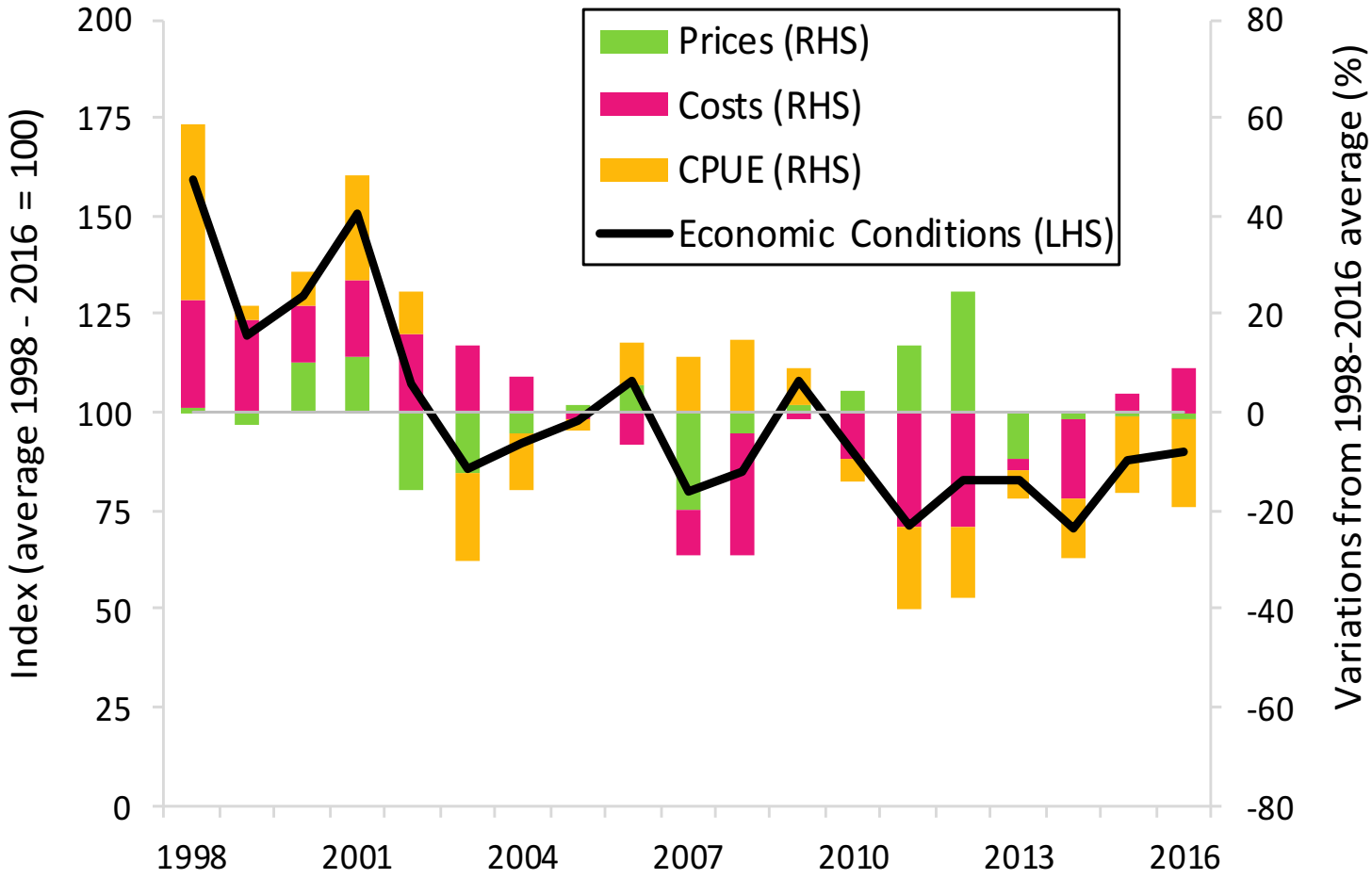
SP Albacore – Economic objectives



SC13-ST-WP-08 Figure 1: Economic conditions index for SLL

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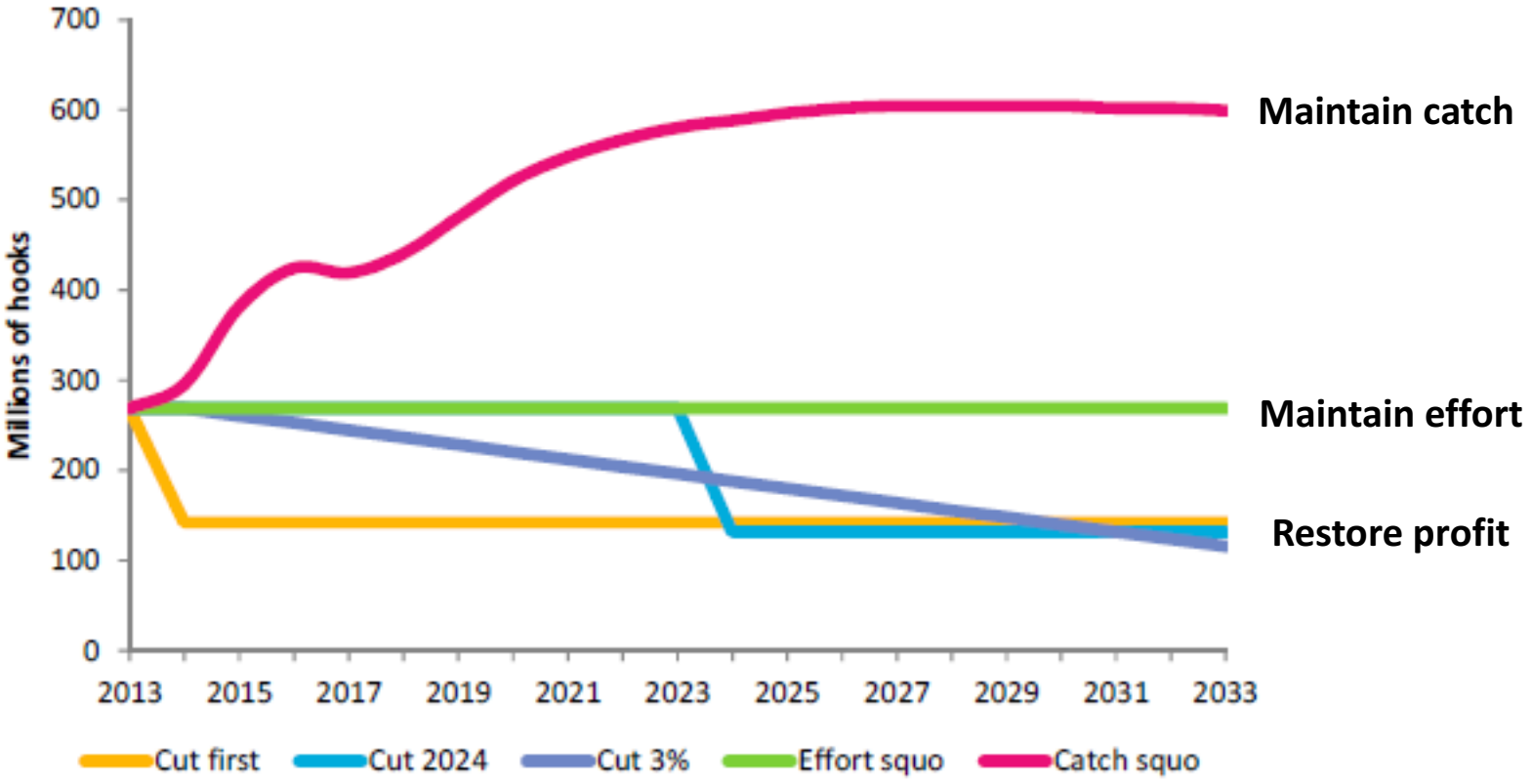
SP Albacore – Management trade-offs



SC12-MI-WP-01 Figure5: Effort required in SLL under 5 scenarios

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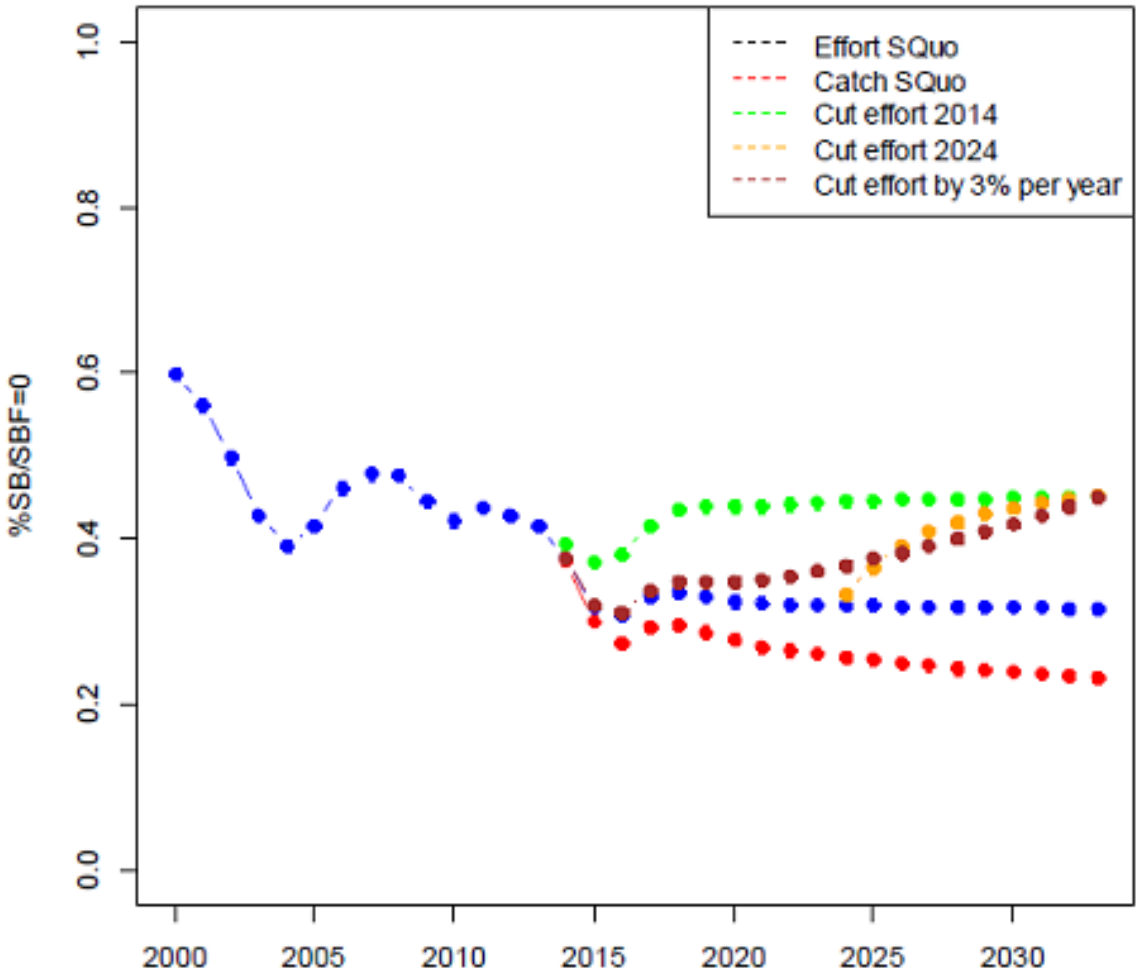
SP Albacore – Management trade-offs



Restore profit

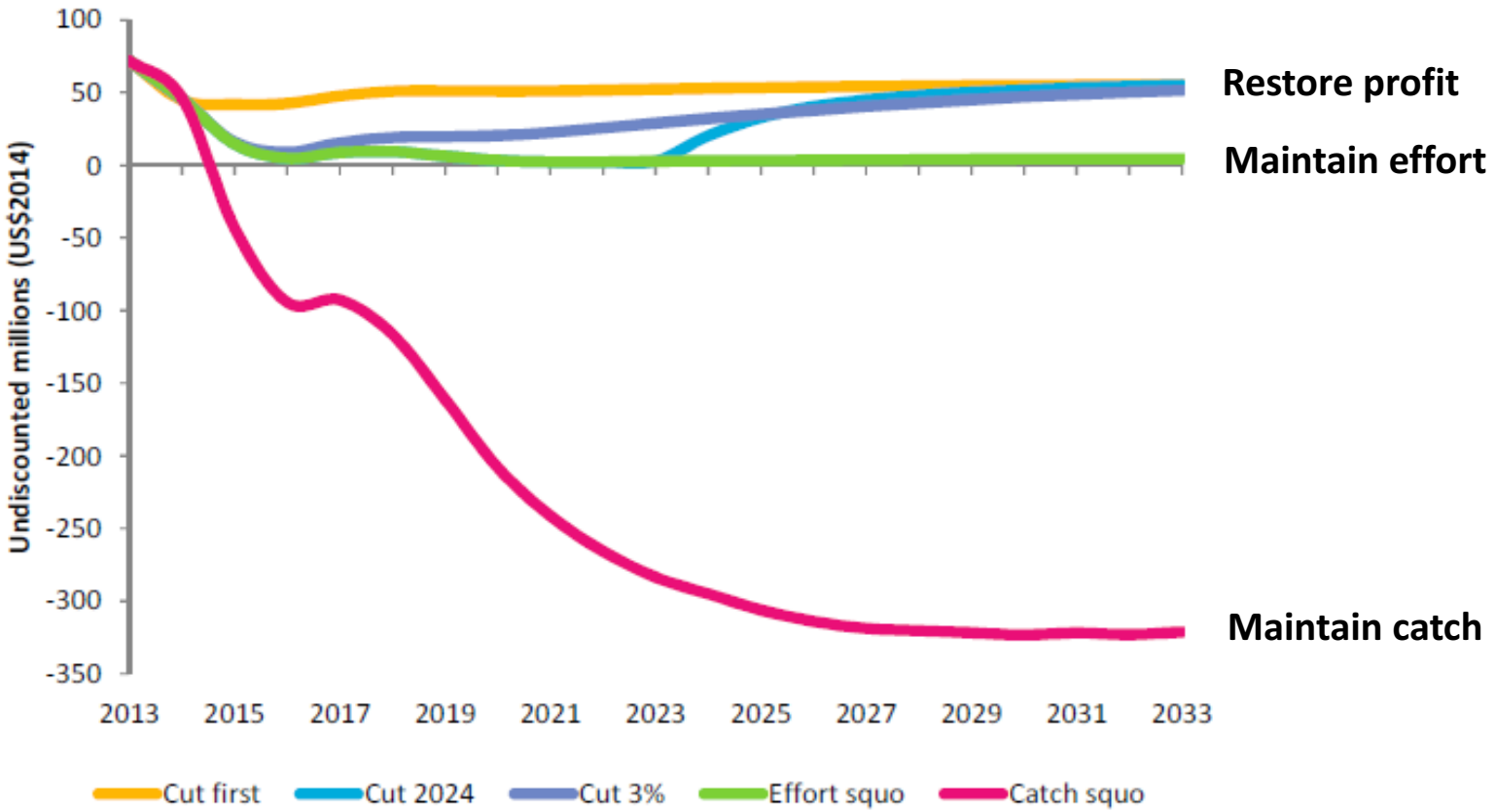
Maintain effort

Maintain catch

SC12-MI-WP-01 Figure 2: Stock status trajectories under 5 scenarios

COMMON OCEANS

SP Albacore – Management trade-offs



SC12-MI-WP-01 Figure 4: Annual profits under 5 scenarios

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SP Albacore – Harvest strategy

COMMON OCEANS

Thank you!

COMMON OCEANS

WESTERN & CENTRAL PACIFIC OCEAN

TUNA MANAGEMENT WORKSHOP

BALI, INDONESIA | 1ST - 2ND AUGUST 2017

Example MSE application: CCSBT

KEMENTERIAN KELAUTAN DAN PERIKANAN

FAO FIAT PANIS

gef

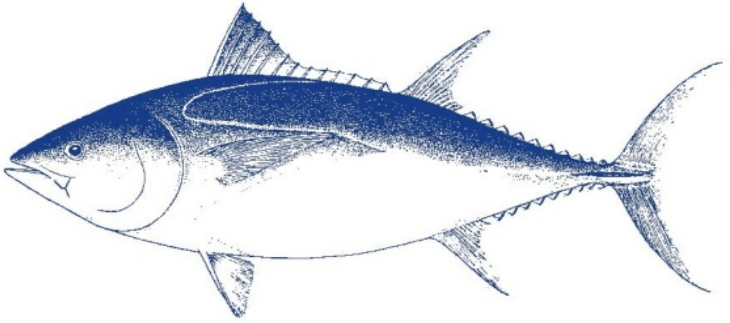
ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

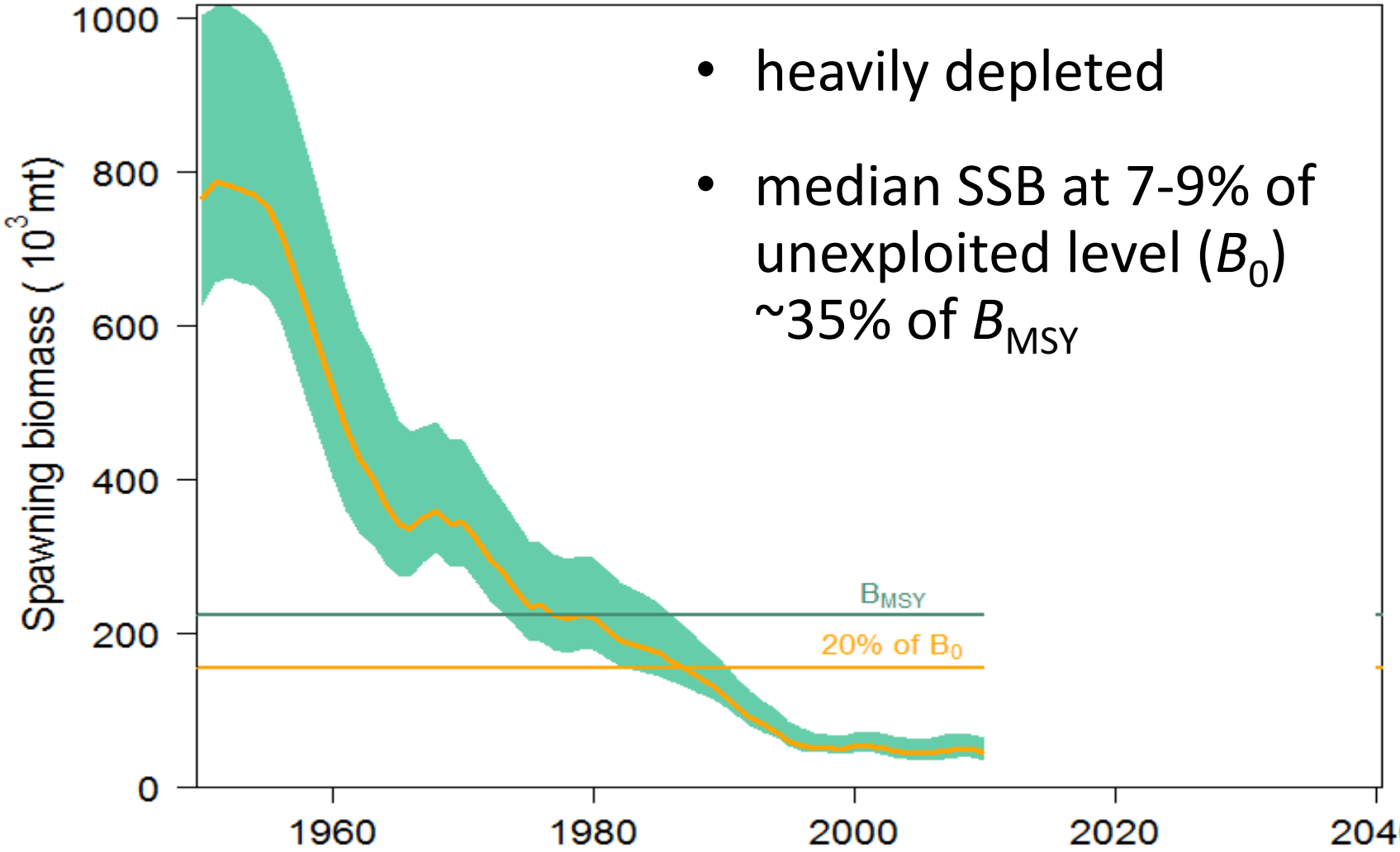
WWF

SUPPORTED BY:

OCEAN OUTCOMES

SBT stock status





- heavily depleted
- median SSB at 7-9% of unexploited level (B_0) ~35% of B_{MSY}

N OCEANS

In 2001 CCSBT approved a multi-year plan for the Scientific Committee to design a rebuilding plan for SBT

Scientists from member countries designed and simulation-tested candidate management procedures

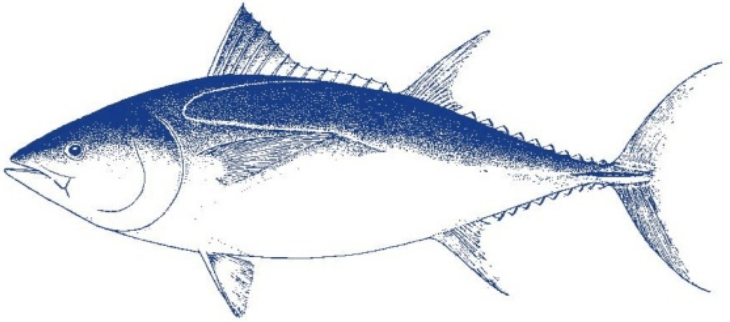
With feedback from Commissioners








SBT Process adopted



Recruitment failure detected in the early 2000s prompted drastic immediate reductions in catch

In 2011 the CCSBT adopted "the Bali Management Procedure"

COMMON OCEANS

The approach towards MSE

Annual workshops (4) with very clear terms of references that set clear benchmarks

All scientists used same code and agreed protocols to test procedures of their choice

Iterative consultative process:

- To inform stakeholders and
- To get feedback about alternatives and priorities between conflicting objectives

Candidate HCRs jointly evaluated using a series of performance statistics

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Step 1- Choice of operating models

Key axes of uncertainty

Level of productivity (*steepness of SR*)

Level of natural mortality

Interpretation of CPUE

5 approaches to calculate CPUE

Possibility of density-dependent catchability

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Translating convention objective to HCR Testing

Managers to define explicit goals/objectives

The Scientific Committee would try to design an MP that would meet those goals/objectives

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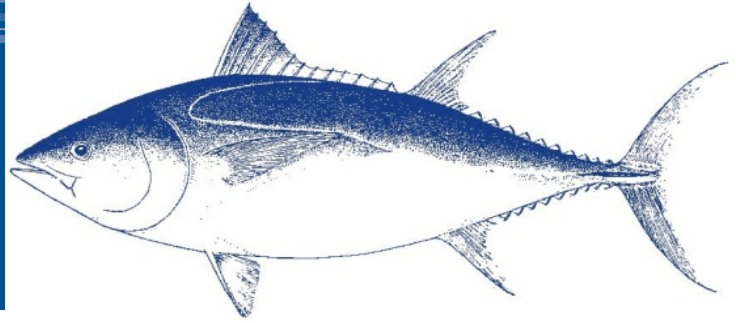
What managers and industry wanted

Rebuild the stock to 1980 levels by 2020
Reduce short-term risks to the stock
Hold catches at current levels or higher if the stock increases
Reduce year-to-year variability in catches

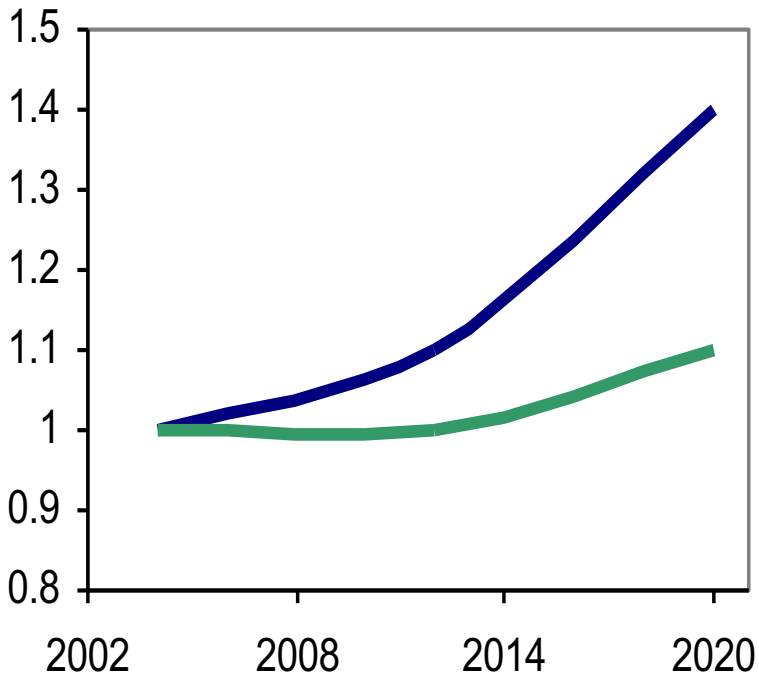
Evaluating trade-offs needed for informed decisions

COMMON OCEANS

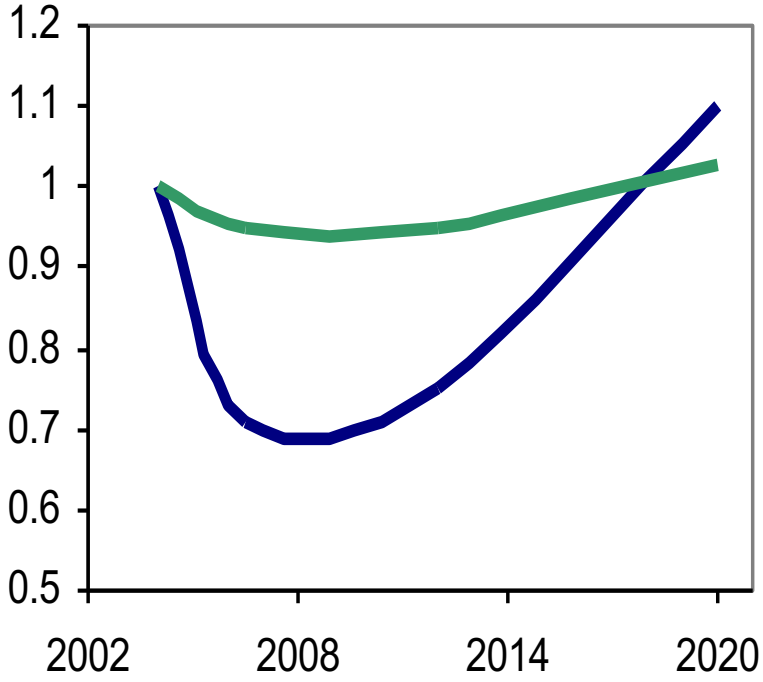
Trade-offs between rebuilding levels and catches



Spawning biomass

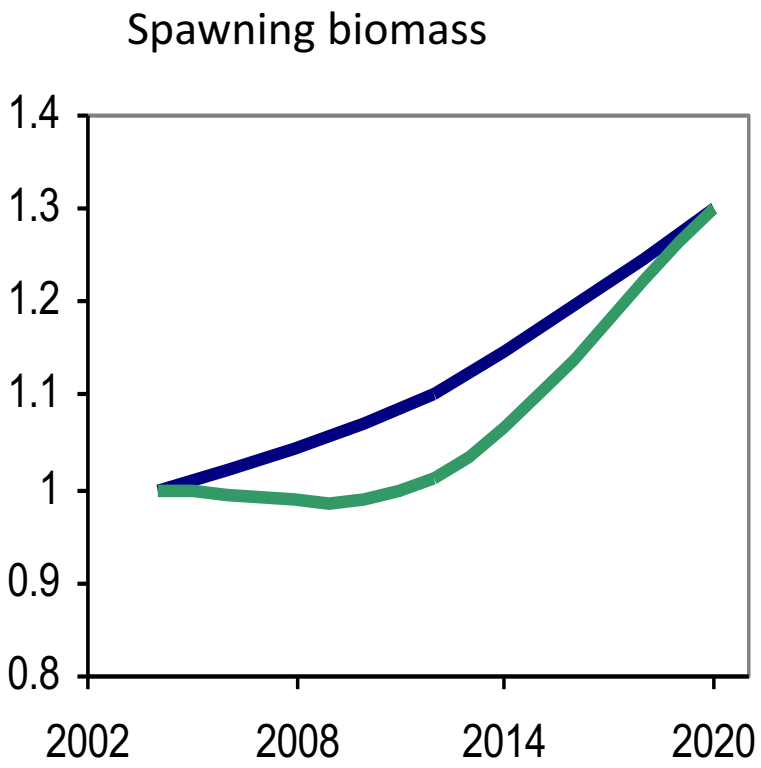


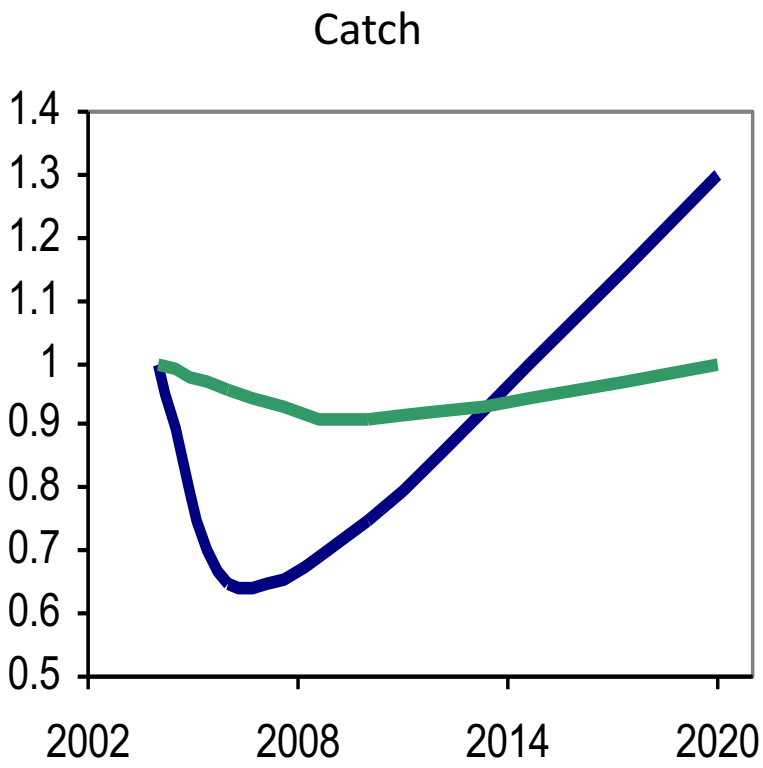
Catch



COMMON OCEANS

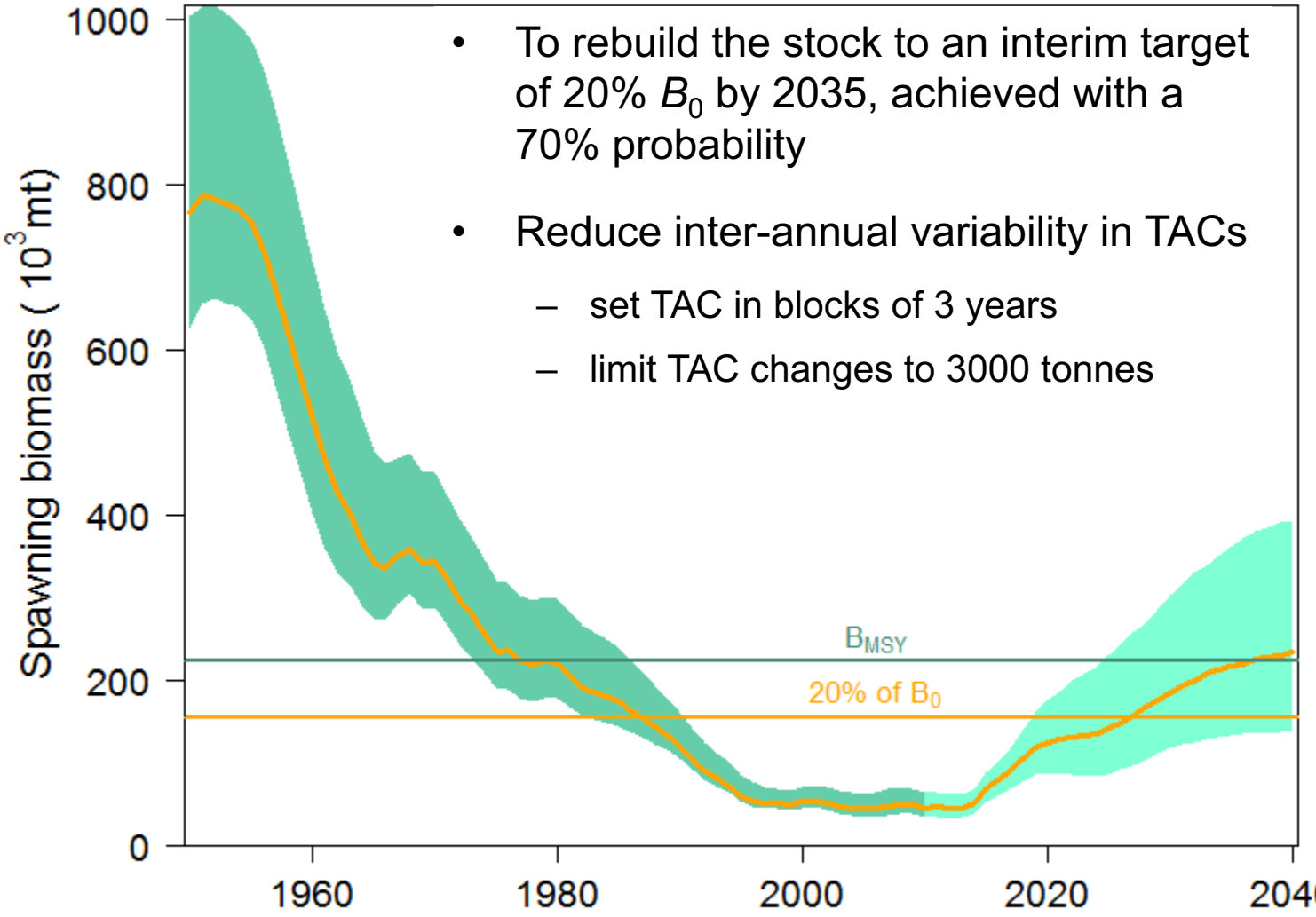
Trade-offs: short-term catch stability and risks





COMMON OCEANS

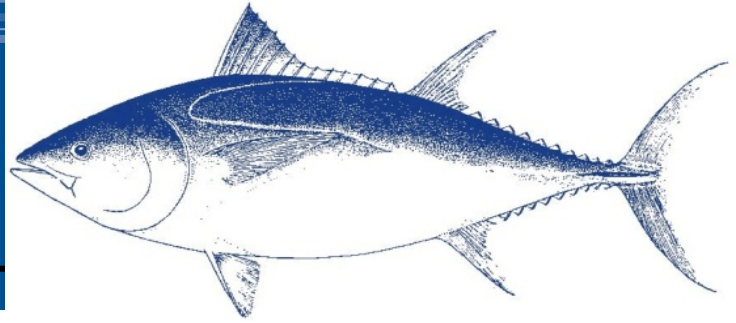
The Bali Management Procedure



- To rebuild the stock to an interim target of 20% B_0 by 2035, achieved with a 70% probability
- Reduce inter-annual variability in TACs
  - set TAC in blocks of 3 years
  - limit TAC changes to 3000 tonnes

COMMON OCEANS

The decision rules: two components



1) The “**autopilot**”

   A rule used to calculate TACs as a function of the data, which has been found to perform robustly

2) **Meta-rules** in case exceptional circumstances not contemplated when simulations completed

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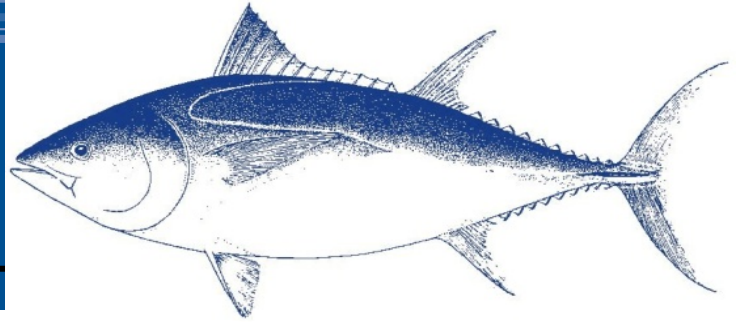
The auto-pilot



Many different types of decision rules were tested, some model-based, some empirical

$$\mathrm{TAC}_{\mathrm{next}} = w\mathrm{TAC}_{\mathrm{current}} + (1-w)\ \mathrm{function}\begin{pmatrix}\mathrm{CPUE}\\ \mathrm{Aerial\ survey}\\ \mathrm{Catch}\\ \mathrm{Age-comp}\end{pmatrix}$$

By changing the parameter values, each decision rule could be "tuned" to achieve different rates of rebuilding

The chosen model-based MP adjusts TACs in response to trends in indicators of stock status and to whether estimated biomass is above or below a threshold level

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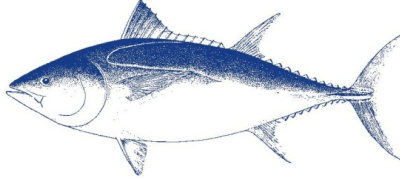
Metarule process



Every year

Every 3 years

Review of stock and fishery indicators

Exceptional circumstances?

In depth stock assessment

Exceptional circumstances?

no

yes

no

yes

Apply MP-derived TAC

If exceptional circumstances, advise on other measures

Are exceptional circumstances so severe that immediate action on TAC is required?

no

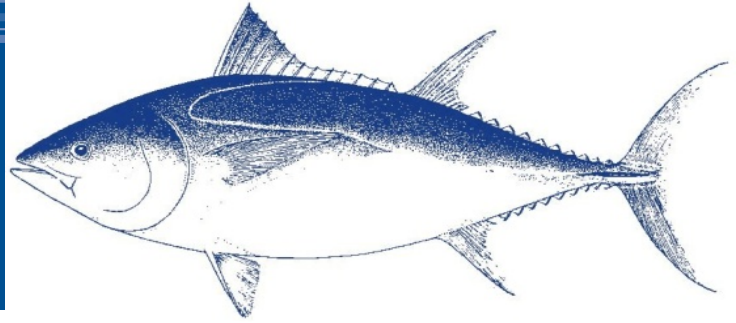
yes

Invoke metarule

Do not apply MP-derived TAC

Advise on TAC

CCSBT MSE



- Built consensus
  - ✓ Changed science focus from debate on abundance estimates and immediate TACs, to design of testing protocols for robust decision rules
  - ✓ Rebuilding goals established by CCSBT after weighing short-term risks and costs
- Quantified trade-offs
- Procedure robust to major assessment revisions
  - ✓ Avoided abrupt changes in TACs that would have resulted had a “best assessment model” been used
- Valuable exchanges between industry, managers and scientists

Communication was key

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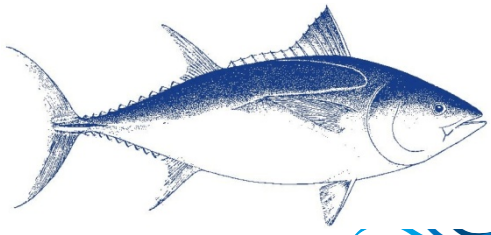
Summary of HCR development

- Changed focus of scientific process **from** endless debates on abundance estimates and TACs **to** discussion of the testing protocols used for developing effective decision rules

- Testing of alternative decision rules transparent to all members

- Valuable exchanges between industry, managers and scientists

Communication key



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Thank you!