



Management Procedure Development of Southern Bluefin Tuna

Future of the most valuable fish
in the world

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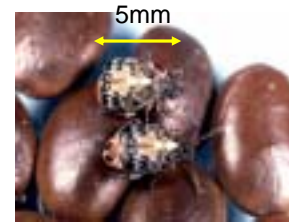
Thank you for your nice introduction and it is nice to see you here.

I am happy to tell you today about something very interesting for all of us in stock management.

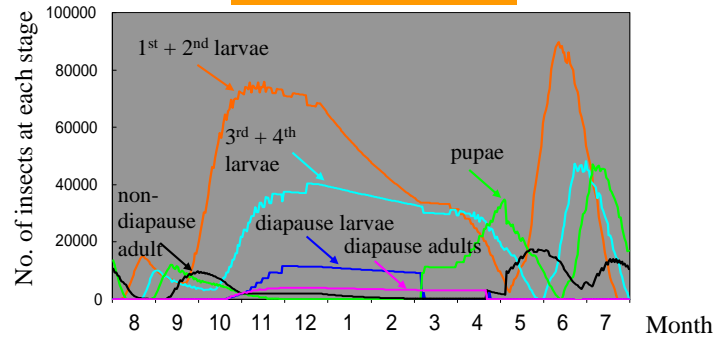
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PhD study 1999-2002 at Univ. of Tokyo

“Population dynamics and evolution of life history schedules in herbivorous insects: overwintering strategy in a bruchid seed beetle, Bruchidius dorsalis. “



Stage Structured Model



First let me tell you about myself.

I've been studying the stock assessment and management procedure of southern bluefin tuna in Japan for the last four years.

(I am currently studying the modeling with the help of Ray and Jim here.)

Actually, before that, I had been studying population dynamics and life history evolution of a small beetle at the University of Tokyo for my PhD.

Field research, experiments and computer simulation, I had a very good time.

(In term of modeling, insect ecology and fishery science have both similarities and differences.

I can learn a lot from studying both fields and I want to create a new field in the future.)

(click)

Welcome to Shimizu!



I've also been interested in conservation ecology and wild life management.

So I am very happy to study tuna management in Shimizu now.

The port of Shimizu is the biggest importer of tuna in Japan.

(It takes only one hour from Tokyo by the shinkan-sen express.)

Shimizu is a very nice city and I love it.

Welcome to Shimizu!

(click)



Today's talk

"Management Procedure (MP) Development of Southern Bluefin Tuna"

- Introduction of SBT
- MP development in CCSBT
 - Process of MP development
 - Construction of Operating Model (OM)
 - Test of MP performance
 - Selection of MP
 - Current problems and Future plan

Let's begin.

Today I will talk about management procedure development of southern bluefin tuna, or SBT.

Management procedure, or MP, is being developed by the commission for the conservation of southern bluefin tuna, or CCSBT.

You can see here the outline of my talk.

First, I will explain about biology and fisheries of SBT.

Next we'll examine the process of MP development.

After that, we will look at the construction of the operating model, test of MP performance and selection of MP.

Finally, I'll show you current problems and future plan.

Each process is very interesting, but today I'd like to try to present the broad overview.

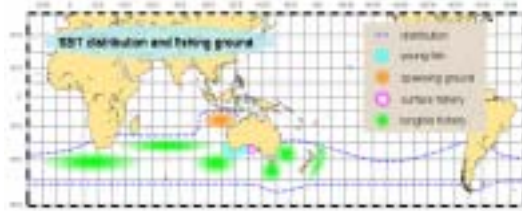
Unfortunately, I'm still not very good at English, so if you have a question, please ask me in slow English.

(click)

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Biology

Southern Bluefin Tuna (*Thunnus maccoyii*)



- Distributed mainly in waters between 30°S and 50°S.
- The only known spawning ground is south of Indonesia (single stock).
- length >2m, weight >200kg
- age of maturity >age10
- longevity >40 years



First, let's talk about the biology of SBT.

SBT distributes mainly in waters between 30 and 50 degrees south.

The only known spawning ground is south of Indonesia in the Indian Ocean, so they are considered to be a single stock for management.

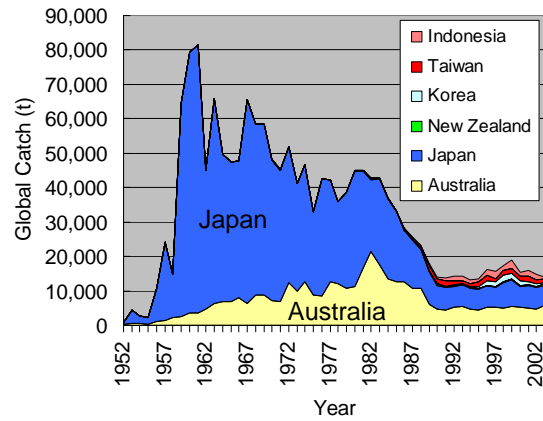
They are large pelagic fish and reach more than 2 meters in length and 200 kilograms in weight.

Otolith studies indicate that they mature after 10 year and live up to forty years.

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Fisheries



- Global catch remains at about 15,000 t after 1990.

Next I'll tell you SBT fisheries.

Historically, Australia and Japan are two main fishing countries.

Fisheries started in the 50s and they caught 80,000 tons at their peak.

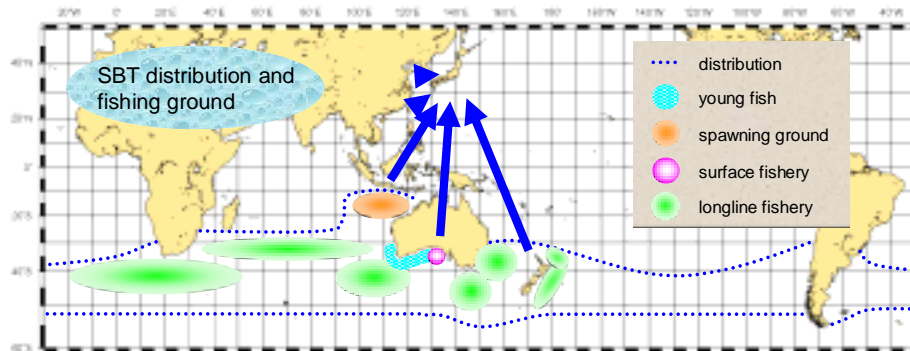
However, after that the catch continued to decrease and the global catch has remained at about 15,000 tons after 1990.

This is because stock abundance declined and a quota system was introduced in 1985.

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Fisheries (cont.)



■ Purse seine fishery

- Australia
(age 2-4: farming)

■ Longline fishery

- Japan, Taiwan, Korea, NZ
(age 4-10)
- Indonesia (age >10)

Now Australian purse seine fishery catches juveniles for farming (in the Great Australian Bight).

Japan, Taiwan, Korea, and New Zealand catch older juveniles and adults in ocean waters by longline.

Indonesia also catches spawning adults un-intentionally and this by-catch issue is one of big management concerns.

So, different countries catch fish at different ages by different ways.

SBT fisheries are characterized by this.

(click)

Now most of SBT are exported to Japan for sashimi.

(click)

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Price “the most valuable fish in the world”



A Billion dollar industry !

→ Entomologist
3,000\$/month

→ SBT
200kgx 100\$/kg
= 20,000\$

(As you know from this slide,) SBT is one of the most valuable fish in the world. SBT industry is smaller than other tuna industries, but it is very huge, a billion dollar industry.

I've been studying SBT for four years, but honestly I've never tasted it.

This fish was caught by me (during field research) two years ago.

It was the biggest that I've ever seen, and it weighed 200 kg.

(click)

If this fish's condition was very good, the price (at the fish market) would be 100 dollar per kg, so this fish is worth 20,000 dollars.

(click)

I would have to work for seven months to buy it.

(click)

Stock status



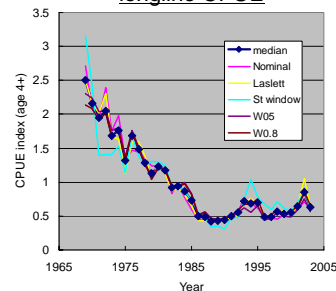
“NOT VERY GOOD ! ”

- 2004 SAG report
- ... the SBT spawning biomass is at a low fraction of its original biomass and well below the 1980 biomass. The stock is estimated to be well below the level that produces maximum sustainable yield...
- ...the probability of further stock decline under current catch levels is now judged to be greater than in 2001, when an increase or decline under current catches were considered equally likely.

an example of assessment result



longline CPUE



This is an agreed statement about stock status this year.

If you want to, you can read it later.

What it says is “the stock status is not very good”.

(click)

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Let's go on to the main subject.

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CCSBT - Commission for the Conservation of Southern Bluefin Tuna



- All decisions are by common consent.
- 1985 Tri-lateral Commission (Australia, Japan, New Zealand) reduces Quota.
- 1994 CCSBT starts.
- 1998 Court case (Aus/NZ vs Jpn)
 - Japanese EFP for testing CPUE hypothesis
- 2002 Korea and Taiwan join.

Currently, SBT is managed by CCBST.

In this commission, all decisions are by common consent(, not by majority).

This commission started in 1994 and original member countries were Australia, Japan and New Zealand.

In 2002, Korea and Taiwan also joined, now CCSBT functions well.

However, in the past, Australia and New Zealand took Japan to the International Court of the Law of the Sea.

They disputed over the Japanese experimental fishing program for testing CPUE hypothesis.

However, the judgment was that problems on SBT should be solved in the CCSBT, not the court.

SBT is famous fish politically, too.

I believe this court case leads to management procedure development in CCSBT.

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Management



- Quota for each country
- Scientific Committee (SC) & Stock Assessment Group (SAG)
- Views of stock status are different among member countries because of large uncertainty on assessment results.
- It is unrealistic to agree TACs based on an annual assessment process.
- CCSBT decided to develop MP in 2001.

Management is conducted by setting a quota for each country.

The scientific committee, or SC, and the stock assessment group, or SAG, make management's recommendation to the commission.

(click)

However, views of stock status are different among member countries because of large uncertainty on assessment results.

It is unrealistic to agree TACs based on an annual assessment process.

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Therefore, CCSBT decided to develop MP in 2001.

(click)

What's MP?



- “A MP is defined as a set of rules that are agreed in advance, that dictate how the TAC for the fishery will be adjusted as new data are collected.” (2001SC report)
- “management strategy”, “harvest strategy”, “decision rule” etc.
- IWC(1992) “Revised Management Procedure”
- MPs are used increasingly for some fish and lobsters.

Even though you may already know, what's MP?

CCSBT defines that a MP is a set of rules that are agreed in advance, that dictate how the TAC for the fishery will be adjusted as new data are collected.

I think that this phrase “agreed in advance” is important in CCSBT.

(click)

“Management procedure” is also called “management strategy”, “harvest strategy” and “decision rule”.

The revised management procedure of the International Whaling Commission is famous as the first development of MP.

After that, MPs are used increasingly for some fish and lobsters, especially in the southern hemisphere.

(click)

Advantages of MPs



- To guide the process of quota setting which does not demand an agreement on a preferred assessment approach.
- To develop more robust MPs to uncertainty by pre-testing them adequately.
- To provide a better chance of achieving management objectives.
- Necessary to make a number of decisions in advance.
- This tremendous challenge receives much attention from other fishery commissions.

What are advantages of MPs?

The CCSBT report says that MP guides the process of quota setting which does not demand an agreement on a preferred assessment approach.

(click)

More generally, it is possible to develop more robust MPs to uncertainty by pre-testing them adequately, and they will provide a better chance of achieving management objectives.

(click)

As stated above, MP has many advantages, but it is also necessary for scientists, industries, and commissioners to make a number of decisions in advance.

In addition, this is the first MP for international pelagic fish.

In that way, this project in CCSBT is a tremendous challenge and this receives much attention from other fishery commissions, especially international tuna commissions.

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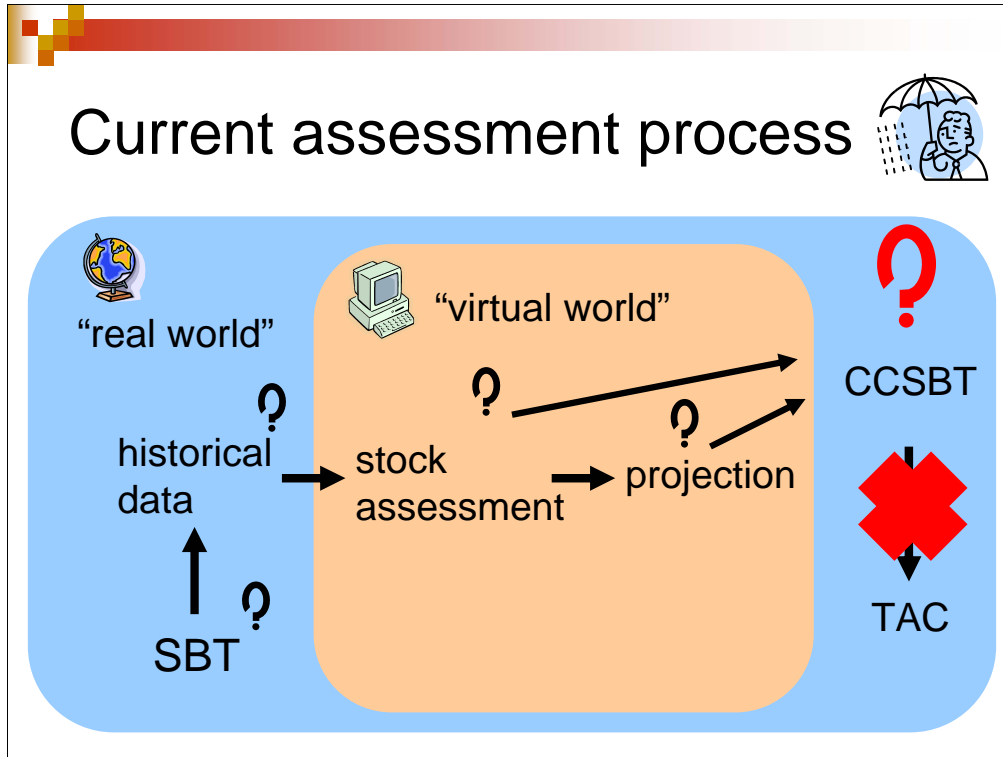
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Here let me talk about a framework of the process of MP development in CCSBT.
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First, as a reference, I will show you the current assessment process in CCSBT.

This blue area indicates "real world" and this brown area indicates "virtual world" inside of computers.

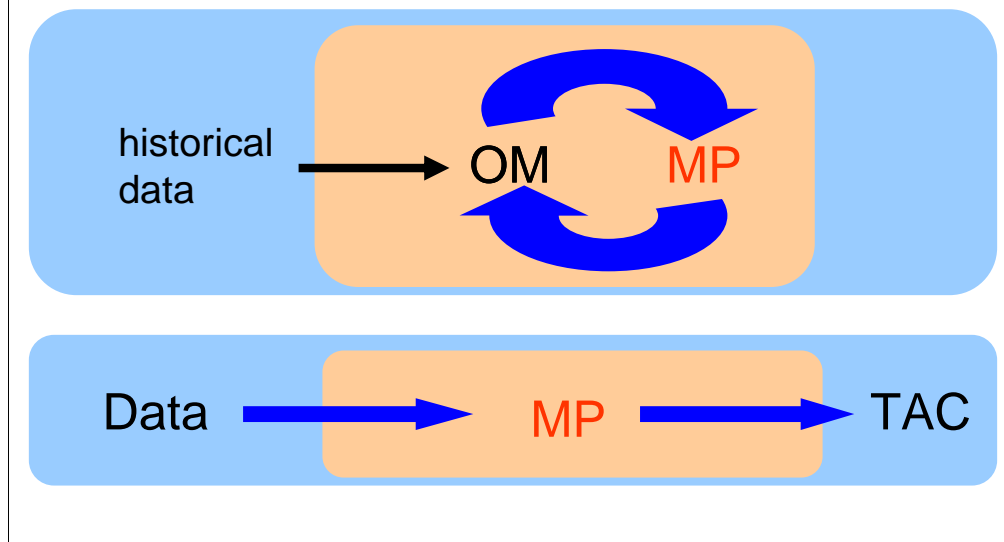
In the current assessment process, first stock assessment is conducted, then projection is examined by very simple rules such as constant catch and constant F.

Based on these results, scientists and decision makers try to determine TAC, but there are many uncertainties in each step, so we don't reach agreement on TAC.

Even if we could, we won't be sure that our decision achieves management objectives.

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MP development & TAC by MP



On the other hand, in the MP development, we can test MPs using Operating Model, or OM, adequately in advance, and so we can get a MP which provides a better chance of achieving management objectives.

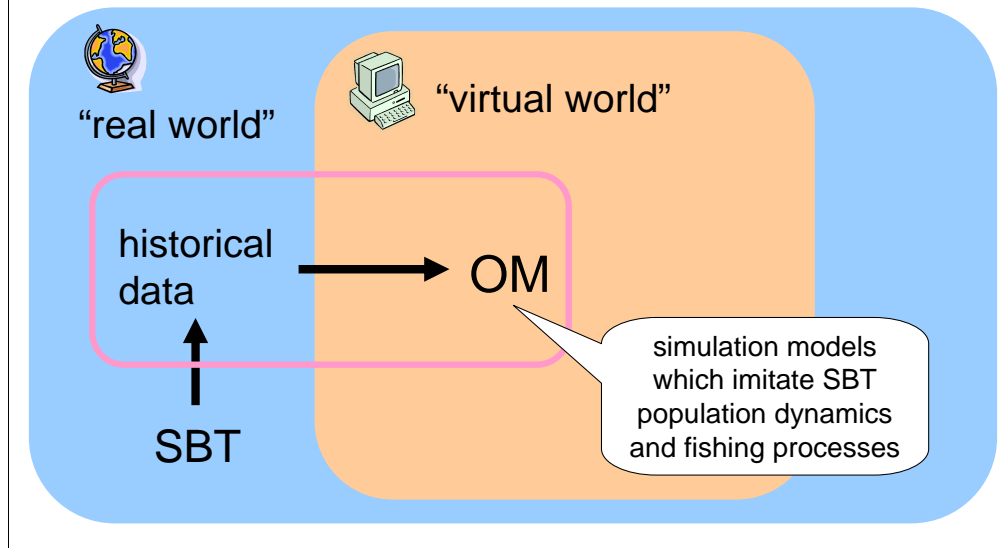
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After MP completion, the MP calculates TAC from data such as fishery data automatically.

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Process of MP development

Step1: construction of OM



We'll look at the development process in more detail.

As the first step, we make operating models used for testing MPs.

In this case, operating models are simulation models which imitate SBT population dynamics and fishing processes in the virtual world.

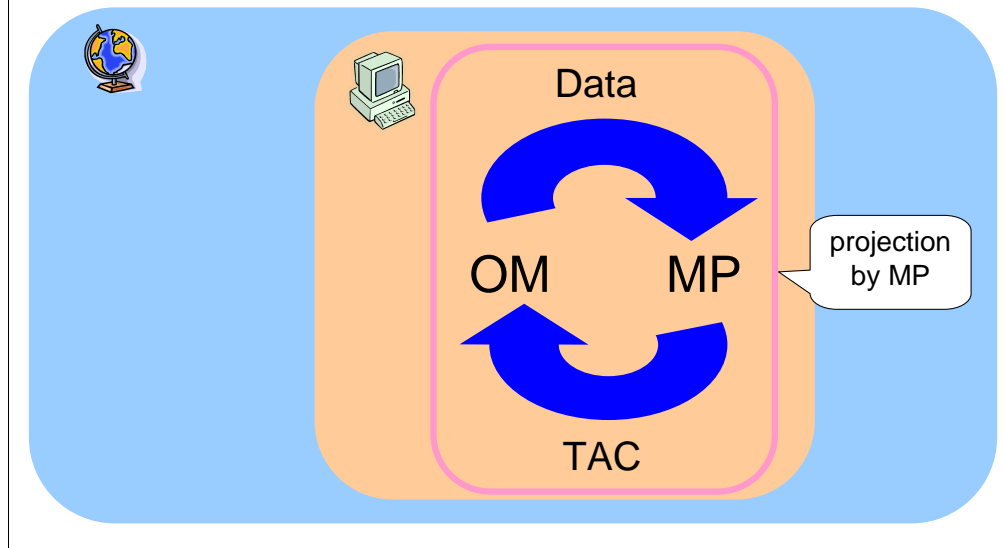
So operating models need to behave like real stock and cover the full uncertainty.

Therefore, operating models are conditioned by historical data.

This process itself is similar to the stock assessment, but the main objective is different.

(click)

Process of MP development Step2: test of MP performance



As the next step, MPs are tested using the OMs.

You can say that this process is projection by the MP.

The OM provides fishery data, like CPUE, to the MP.

The MP determines TAC based on the data.

And the OM receives the TAC from the MP and calculates stock dynamics of the next year.

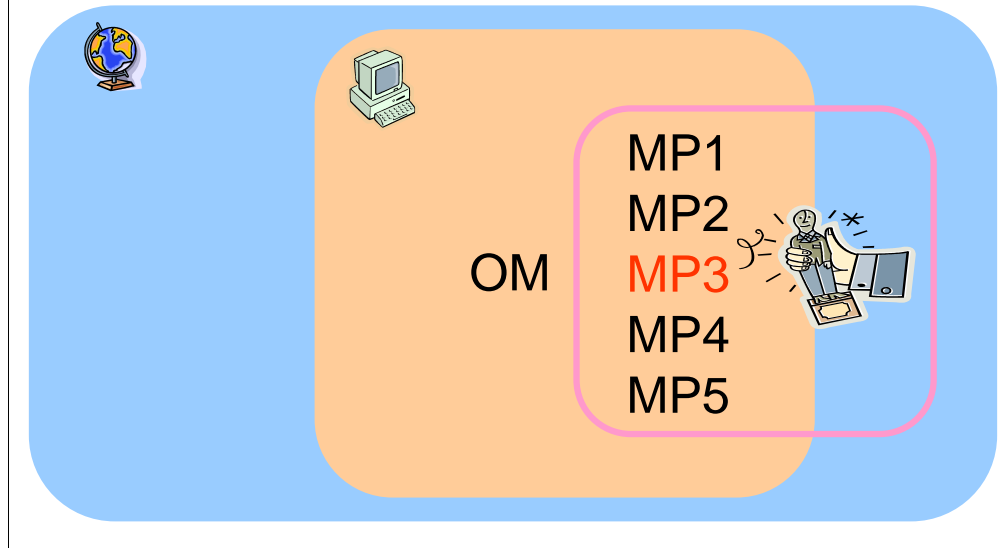
This cycle continues for projection periods.

And MP performance is evaluated from this projection result.

(This process is done by computers.)

(click)

Process of MP development Step3: selection of MP



Probably many MPs will be developed and tested.

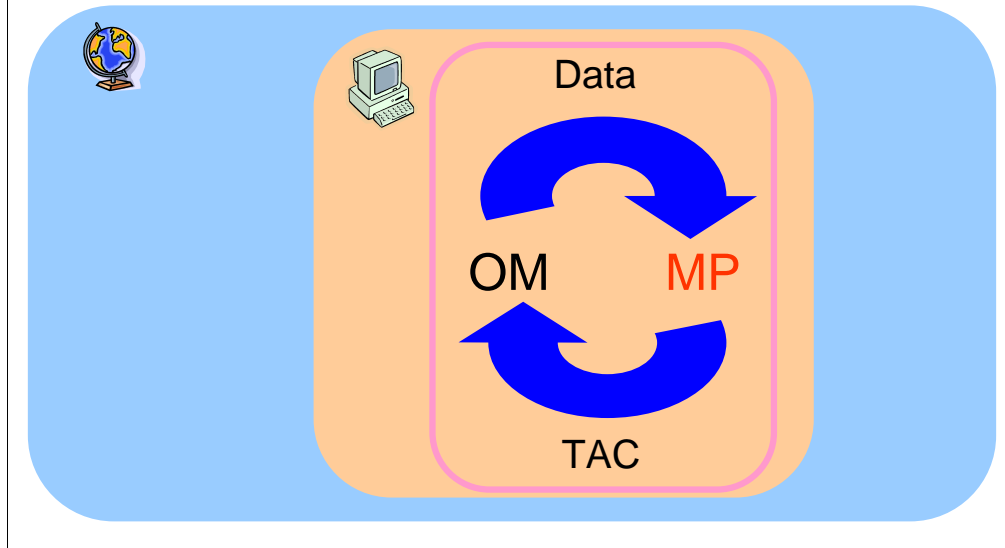
So we should select one of them.

It's not surprising that the selection depends on the preference of decision makers.

(Generally, MP which shows better performance robustly to uncertainty could be acceptable.)

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Process of MP development Step4: MP implementation



Let's use the selected MP in the real world.

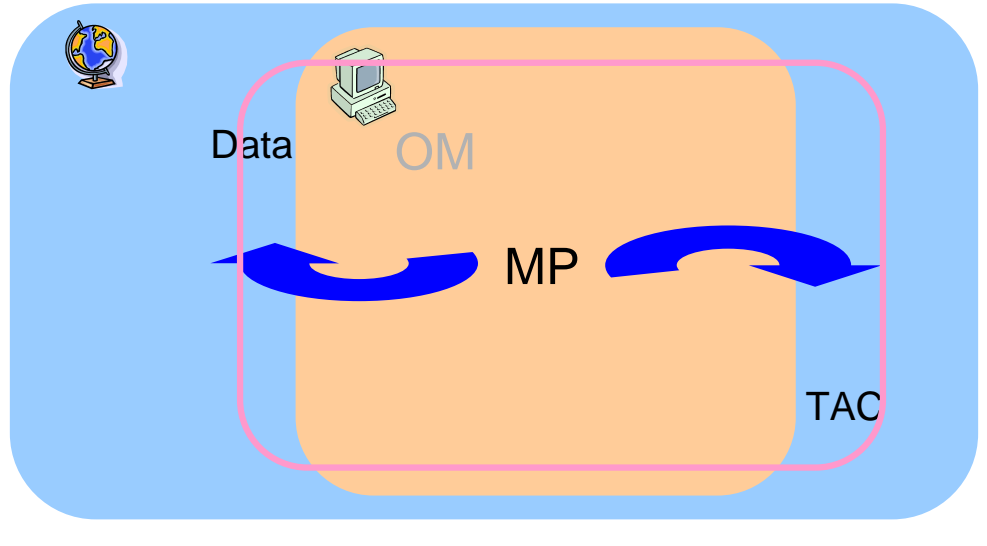
OM is not necessary any longer.

Good-bye, OM.

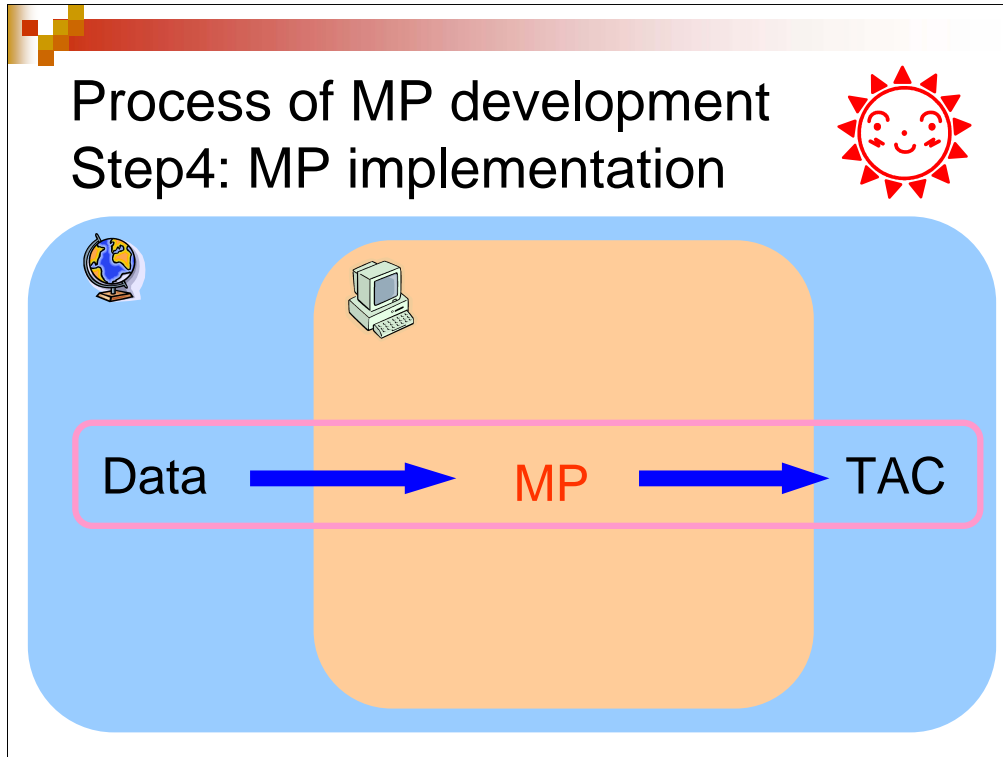
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Process of MP development

Step4: MP implementation



Process of MP development Step4: MP implementation



We got it.

Once we complete the MP, basically, we just have to input fishery data to the MP every year.

The MP will provide TAC automatically.

Off course we should check whether the MP works as expected.

But we don't have to dispute over the stock assessment process every year.

(click)

Management objective



- The original management objective is returning the spawning biomass to 1980 levels by 2020.
- However, current projection shows that substantial quota reductions would be required to achieve that goal.
- CCSBT has agreed that this objective will be reviewed in the MP development.

Here I'd better tell you about the management objective of CCSBT.

The original management objective is returning the spawning biomass to 1980 levels by 2020.

(click)

However, current projection shows that substantial quota reductions would be required to achieve that goal.

(click)

So CCSBT has agreed that this objective will be reviewed in the MP development.

This means that we have to consider management objectives and management procedure at the same time.

(click)

Main cast

- National scientists
 - Australia - T.Pollachek, M.Bason, D.Kolody
 - Japan - S.Tsuji, D.Butterworth, K.Hiramatsu, H.Kurota
 - New Zealand, Korea, Taiwan
- Independent chairs
- Advisory panels
 - R.Hilborn, J.Pope, J.lanelli, A.Parma (**MP coordinator**)
- MP consultant
 - V.Haist



Pictures thanks to K.Hiramatsu

Before looking at each technical step, let me introduce our MP cast in CCSBT.

What I tell you today is the achievement made by all of us.

MP works have been done mainly by the SAG members.

This MP group consists of national scientists, independent chairs, advisory panels and a consultant.

Independent chairs and advisory panels were established in 1999 to facilitate consensus among member countries.

Current panel members are Ray Hilborn, John Pope, Jim lanelli, and Ana Parma.

Ana is a coordinator of this MP project, too.

I think their contribution is very important.

Without their help, this MP project would not have progressed as it has.

(click)

By the way, 80% of the meeting time is spent by listening to these two men fighting.

(click)

World tour



OM and MP upgrade at each meeting.

- 2002/4 1st MPWS (Tokyo, Japan)
- 2002/9 3rd SAG (Canberra, Australia)
- 2003/4 2nd MPWS (Queenstown, NZ)
- 2003/8 4th SAG (Christchurch, NZ)
- 2004/4 3rd MPWS (Busan, Korea)
- 2004/9 5th SAG (Jeju, Korea)

This MP project actually started in April 2002.

We have had six meetings around the world so far.

Both OM and MP upgrade at each meeting as originally planned.

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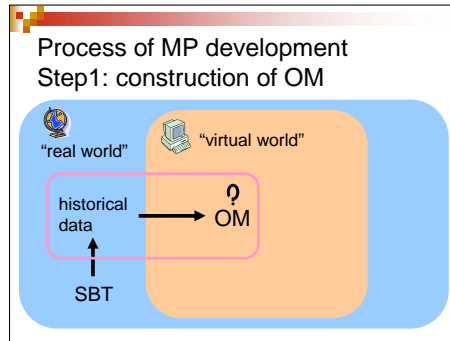
Today I'd like to talk about the results in April 2004 in Busan.

I'll refer to problems after April later.

(click)

Today's talk

- Introduction of SBT
- MP development
 - Process of MP development
 - **Construction of Operating Model (OM)**
 - Test of MP performance
 - Selection of MP
 - Current problems and Future plan



Let's look at each step of MP development.

First, we will look at the construction of operating model.

(click)

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Specification of OM

- To imitate actual SBT dynamics and fishing process with enough uncertainty
- Basic structure
 - single stock
 - age-structured model
 - Beverton-Holt SR relationship with process error
 - age-specific selectivity change over time
 - observation error in CPUE


This operating model is developed from a statistical age-structured model by Butterworth, Ianelli and Hilborn in 2003.

The basic model structure of the OM is like this.

This is a normal age-structured model preferred by Seattle scientists.

Honestly, I was so surprised to see the model specification first, because it was very complicated for entomologists.

(click)



Specification of OM (cont.)

- Historical data (up to 2000)
 - grouped into five fisheries
 - total catch
 - catch at age and size
 - tagging data
 - Japanese longline CPUE

 - Age-length relationship and age of maturity are given.

These data are used in this model as historical data and all data are up to the year 2000.

(click)

Specification of OM (cont.)

- “Conditioning”
 - OM is fitted to historical data and indices.
 - likelihood components
 - Japanese longline CPUE
 - catch at age and size
 - tagging data
 - recruitment residuals
 - penalties on changes in selectivities
 - Some parameters (M etc.) have priors.
 - estimated parameters
 - B_0 , q , σq , M , rec deviation, selectivity, steepness

OM is fitted to these historical data and indices.

We called this process “conditioning”.

These are likelihood components.

And some parameters, such as natural mortality, have prior assumptions.

Under these conditions, we estimated these parameters.

(click)

Conditioning results: OM “reference case”

- integration of “scenarios”
 - MCMC approach (posterior) and expert judgment
- key uncertainties
 - natural mortality (M)
 - “steepness” of SR relationship (h)
 - relationship between CPUE and abundance (ω)
- OM “reference case” consists of 2000 scenarios.

Now we will look at conditioning results.

This is important and difficult to explain. If you want, you can ask me later or talk to Ray and Jim.

In order to cover enough uncertainty, it is necessary to look at many possible “scenarios”, which means a set of parameter values.

However, at the same time, we have to face a difficulty of integration: Which scenario is more important for testing MPs?

We discussed this problem many times and we decided that basically MCMC approach should be used to integrate parameter uncertainty where appropriate.

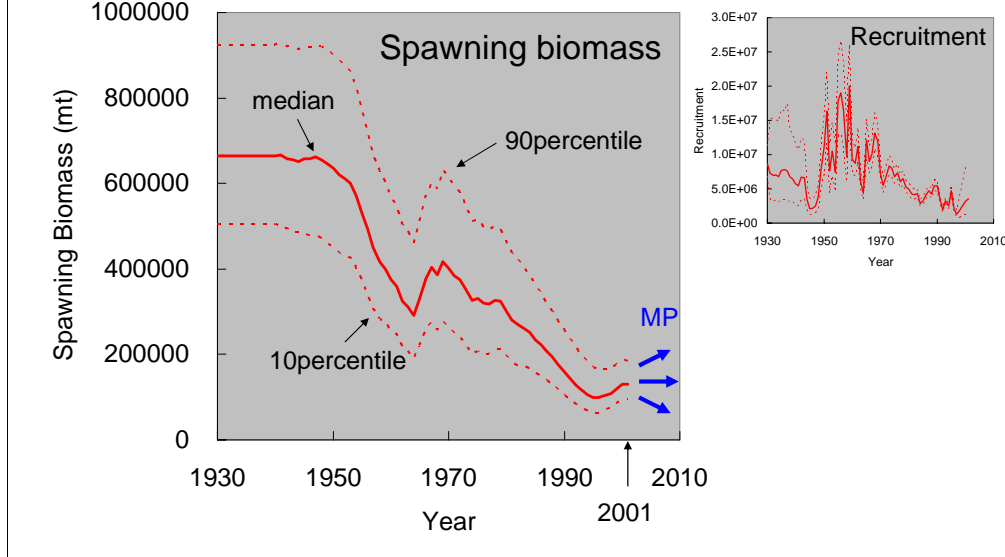
One of key uncertainties, natural mortality, and most parameters were handled with the MCMC approach.

But this approach to steepness and omega parameters was not informative because the likelihood was not reliable, so we determined instead to weigh these parameters by expert judgment.

By these procedures, we were able to get the “reference case” which consists of 2000 scenarios, and we used it as a base OM.

(click)

OM “reference case”



These figures shows spawning biomass and recruitment for the reference case from 1930 to 2001.

This shows posterior distribution.

The projection for testing MPs starts after here.

(click)

OMs “robustness test”

- Other uncertainties are treated as “robustness tests”.
 - age range to standardize CPUE
 - carrying capacity change
 - future catchability change etc.
- 11 robustness tests
- MP performance is evaluated mainly from results for the reference case, but it is desirable that the performance is robust for robustness tests.

There are some other uncertainties, which are difficult to treat by MCMC and are related to future projections.

We treated them as “robustness tests” and selected 11 tests.

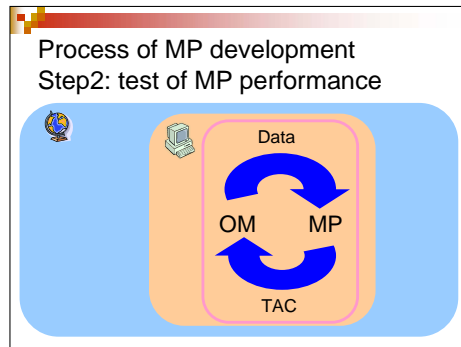
MP performance is evaluated mainly from results for the reference case, but it is desirable that the performance is robust for robustness tests.

(click)

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Today's talk

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Next, we will look at test of MP performance.

(click)

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Projection for testing MPs

- Test MPs for one “reference case” OM and 11 “robustness test” OMs
- Projection from 2002 to 2032
- Available data for MPs from OM
 - longline CPUE, total catch, catch-at-age data
- Consider recruitment variability, CPUE obs. error and selectivity change.
- TAC is changed every 3 yrs from 2008 (default).
- (Quota allocation is fixed.)

First I'll talk about projection specification.

We test MPs for one “reference case” OM and 11 “robustness test” OMs.

The projection period is from 2002 to 2032.

Available data for MPs should be realistic.

So in this projection, MPs can get only these three data from OM.

longline CPUE, total catch, and catch-at-age data.

Basically, MPs determine TAC based on the three data.

(click)

Also these conditions are set to make realistic situations.

(click)

Performance indicator (25!)

- maximizing catches
 - (e.g.) catch over 20 years, $C(2032)$
- safeguarding the stock
 - (e.g.) $B(2032)/B(2002)$, $\text{Min}[B(y)/B(2002)]$
- minimizing inter-annual variation in catch and effort
 - (e.g.) inter-annual variation, maximum of TAC change

We defined performance indicators to quantify MP performance.

(We tried to integrate the indicators to compare MPs easily, but they finally increased to 25.)

They are classified into three categories.

These categories correspond to three ideal objectives: maximizing catches, safeguarding of the stock, minimizing inter-annual variation in catch and effort.

Which category is important depends on people's preference and this influences the MP selection.

(click)

Comparison of MPs

- Trade-off is found between maximizing catches and safeguarding the stock.
- To compare MPs easily, each MP is tuned to a target biomass in the reference case.
- “Tuning”
 - median of $(B_{2022}/B_{2002}) = 0.9, 1.1, 1.3$
- The tuned values of MP parameters are also used for the robustness tests.

But at the early stage of this project, we found a trade-off between maximizing catch and safeguarding the stock.

This is a natural thing, but it is a problem for comparing performance among different MPs.

(click)

So, we decided that each MP, more exactly speaking, control parameters of MP, should be tuned to a target biomass in the reference case.

We call this “tuning”.

Median of this biomass ratio is used as the target biomass.

(click)

This is just confirmation.

MPs are tuned only in the reference case.

Of course the tuned values of control parameters are also used for the robustness tests.

(click)

MP “HK5” (“Hiroyuki Kurota ver.5”)

- adaptive management
- TAC is set as a minimum of TAC value specified using CPUE slope of age 4+ (stock trend) or CPUE level of age 4 (recruitment).

$$TAC_{y+1} = \min \left(TAC_{y+1}^{trend4+}, TAC_{y+1}^{level4} \right)$$

$$TAC_{y+1}^{trend4+} = TAC_y \times (1 + k\lambda)$$

: slope of regression of
 $\ln(CPUE_{age4+})$ over 10 yrs

k : control parameter

$$TAC_{y+1}^{level4} = TAC_y \times (a \times CPUE_{age4, y-1} + b)$$

a, b : control parameters

Here as an example of MP, let me show you MP “HK5”.

(click)

I like this MP, because it is mine.

Insects can do complicated work by following a simple rule, so I also tried to develop as simple a MP as possible.

This MP is a kind of adaptive management and feed-back control.

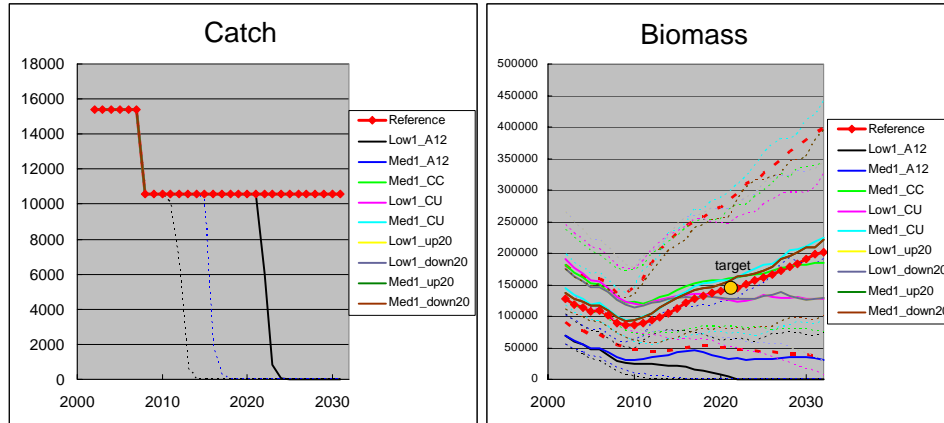
It sets TAC as a minimum of TAC value specified using CPUE slope of age 4+ (stock trend) or CPUE level of age 4 (recruitment).

In my concept, basically, TAC is controlled by stock trend, and in case of low recruitment, TAC is reduced more for stock safety.

These three parameters are control parameters of HK5.

(click)

10,600 tons
MP “constant catch” ($B_{2022}/B_{2002}=1.1$)



- TAC never increases in high productivity OMs.
- Stock collapses in some robustness tests.

For reference, first I'll show you projection results under a constant catch (10,600 tons).

The left panel indicates catch trajectories and the right panel shows biomass trajectories.

This figure includes results for the reference case (red) and 9 robustness trials, when target biomass is 1.1.

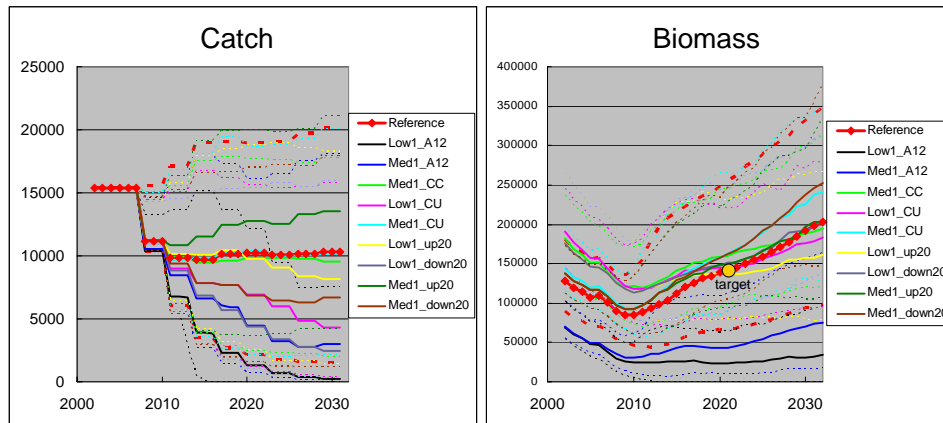
Luckily, this MP can manage reference case without stock collapse.

However, TAC can never increase in all cases and stock collapse is found in robustness tests (black&blue).

This large TAC reduction here is not good from the viewpoint of fishery stability.

(click)

MP “HK5” ($B_{2022}/B_{2002}=1.1$)



■ This MP shows better performance than the constant catch.

How about HK5?

Of course target is the same 1.1, too.

TAC reduction in the beginning time is not small, but it looks like TACs are controlled depending on stock productivity, and stock collapse is hardly seen even for the robustness tests.

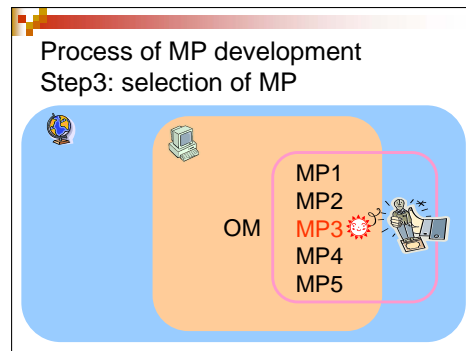
In addition, average catch is also similar to that of the constant catch.

So this MP shows better performance than the constant catch MP.

(click)

Today's talk

- Introduction of SBT
- MP development
 - Process of MP development
 - Construction of Operating Model (OM)
 - Test of MP performance
 - **Selection of MP**
 - Current problems and Future plan



Let's compare with other MPs.

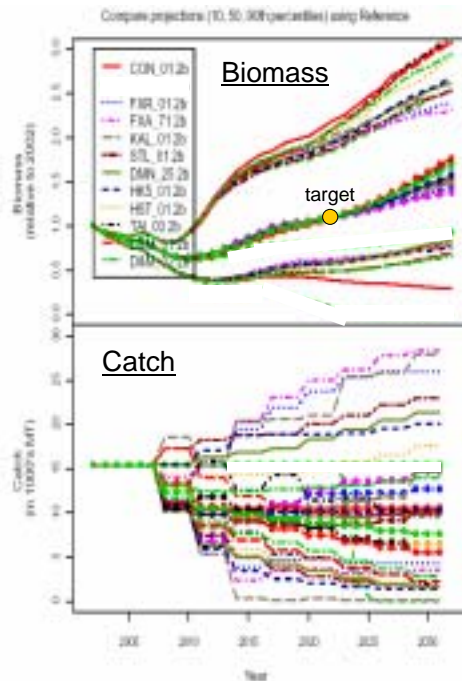
Finally, we'll look at the selection of MPs.

(click)

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Selection of MPs

- 10 MPs were explored in April 2004.
- Median of biomass and average catch were similar because of “tuning”.
- However, range of biomass variation and catch trajectory were different.



Over 30 MPs were developed through this project.

Finally, 10 MPs including HK5 were submitted to the 3rd MPWS in April 2004.

This figure shows the all results for the reference case when target biomass is 1.1.

You don't have to look into it.

You can see the median of biomass is very similar.

Actually, the average catch over 20 years is similar, too.

This is because each MP is tuned to a target biomass and therefore tuning is very important for the selection of a MP.

However, you can also see that range of biomass variation and catch trajectory are different among MPs.

(click)

H: high, M: medium, L: low

Selection of MPs (cont.)

- MPs were evaluated by 15 criteria (target=1.1).
 - early TAC reductions
 - longer term TAC levels
 - risk of low SSB
 - AAV and TAC change
 - robustness tests etc.
- MPs were categorized into four groups.

criteria	MP	FXR	FXR_11	PAL	STL	D&M	HPS	HST	T&E	DSM	DSM	
		01	11	01	01	25	01	01	05	01	02	
early TAC reductions		L	H	H	H	M	M	M	L	LM	L	L
longer term TAC levels		H	H	H	H	M	M	M	L	L	L	L
risk of low SSB (10% SSB and 10% Merit)		L	L	L	LM	LM	LM	LM	HM	H	H	H
Increase in TAC at end of period		H	H	H	H	M	M	M	L	L	L	L
Range of TAC variation	?	H	H	H	MH	M	M	LM	L	L	L	L
Range of biomass variation	?	L	L	L	M	M	MH	MH	H	H	MH	MH
post-2022 median biomass		H	L	L	M	M	M	M	H	H	H	H
probability of low TAC		L	L	M/L	H	M	M	M	M	M	M	M/L
AAV and mean TAC change		L	H	H	H	M	M	L	L	H	L	L
TAC change revenue (Global)		L	M	M	H	M	M	LM	L	H	LM	L
Met1_A12Low1_A12		H	H	H	H	M	M	M	M	L	L	L
No AC		H	M	M	M	H	MH	H	MH	L	M/L	L
Low Rec		H	M	H	M	M	M/L	H	L	L	L	L
Sleepness (high) effect on TAC		H	H	H	H	M	M	M	M/L	L	L	M/L
Sleepness (low) effect on biomass		H	M	H	H	H	M	M	L	L	L	L

Like this, MPs were evaluated and characterized by 15 criteria including results of robustness tests.

This table shows these grading results, when the target is 1.1.

These are MPs and these are criteria.

For example, early TAC reduction should be low ideally.

MP FXR has high reduction, MP STL has medium reduction, and MP D&M has low reduction.

From this table, we found MPs were categorized into these four groups.

Luckily, each category included MPs from the same county.

So we selected the most preferable MP from each category.

(click)

Final four candidates!



- “FXR” (Aus), “D&M” (Japan)
 - model-based MP
 - determine TAC from estimated biomass, BMSY and MSY.
- “HK5” (Japan), “TAI” (Taiwan)
 - empirical MP
 - determine TAC from CPUE only

These are final four candidates.

Two MPs are based on the production model and determine TAC from estimated biomass and BMSY.

The other two MP are more simple empirical ones and TACs are controlled by CPUE only.

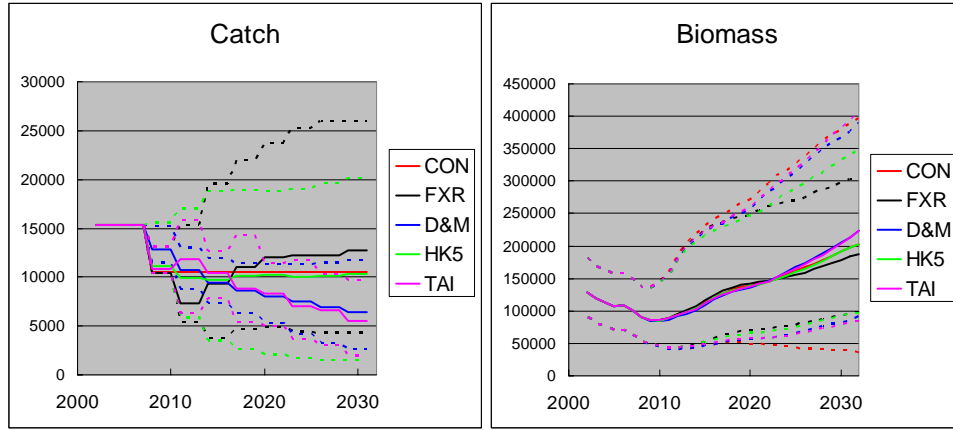
(click)

Hk5 survived the contest.

(click)

Final candidates

	risk of low biomass	inter-annual catch variation	longer term TAC levels
ideal	L	L	H
FXR	L	H	H
D&M	H	L	L
HK5	L/M	L	M
TAI	H	H	L



(reference case, rebuilding target = 1.1)

This graph shows projection results of the four MPs.

For reference, the constant catch result is also shown in this graph.

(In term of low risk of stock collapse, any MPs are better than the constant catch.)

Once again you can see that four MPs are different mainly in catch variation and risk of low biomass.

For example, FXR (black) has high catch variability and low risk of low biomass.

On the other hand, D&M (blue) has low catch variation, but higher risk of low biomass.

HK5 (green) is the medium of the two MPs and provides a good balance.

Looks like TAI is not so good in general.

Actually, it is still not determined who will select the final MP and how they will choose it, but I hope my MP is selected.

(click)



Today's talk

“Management Procedure (MP) Development of Southern Bluefin Tuna”

- Introduction of SBT
- MP development
 - Process of MP development
 - Construction of Operating Model (OM)
 - Test of MP performance
 - Selection of MP
 - Current problems and Future plan

Finally, I'll talk about current problems.

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Current problems



- A final MP was supposed to be selected at the Commission meeting in Oct 2004.
- However, inconsistency of OM prediction and the observation was found in April 2004.
- Data update (up to 2003) and model modification has not solve all problems in Sept.
 - sample size for CAA, tagging data weighting, CPUE obs error, age-dependent M, integration of scenarios

Finally, I'll talk about current problems.

According to plan, a final MP was supposed to be selected at the Commission meeting in Oct 2004.

(click)

However, inconsistency of OM prediction and the observation was found in April 2004.

For example, the OM predicted CPUEs declined after 2000, but actually it is not the case.

So we updated the data (up to 2003) and modified the OM specification, but all problems have not been solved in the SAG meeting in September.

We had a new problem that MCMC was not converged either.

So now we are examining these factors of OMs in a hurry.

(click)

Future schedule

- 2005/2 mini-meeting (Seattle, USA)
 - Finalize OMs
- 2005/5 4th MPWS (Canberra, Aus)
 - Explore MPs and discuss implementation issues
- 2005/8 6th SAG (Taipei, Taiwan)
- 2005/10 12th Commission meeting
 - The final MP will be selected.
- 2006/10 13th Commission meeting
 - TAC will be set by the MP first.

This is our future schedule.

I got good news for you.

Next February, a mini-meeting has been determined to be held in Seattle.

We will finalize OM there.

After that, MPs will be explored using the new OMs.

We also need to discuss implementation issues more practically.

It will include a meta-rule for exceptional circumstances which are not considered in the MP development.

The final MP will be selected next autumn, and probably TAC will be set by the MP in 2006.

Our world tour will continue for a while.

(click)



As you can see, the development and use of MP is complicated, but very important for stock management.

We at CCSBT are working very hard to create MPs to manage SBT very well.

SBT is greatly depleted and decision making for management is not easy, but all fisheries may face similar management problems.

I hope our efforts will be helpful to them.

(click)

Acknowledgement

- All CCSBT members
- NRIFSF members
- Quantitative seminar members
- Ray Hilborn
- Jim Ianelli



2003. 4 2nd MPWS, Queenstown, NZ



2004. 10.1 the Safeco Field

I would like to close by expressing my thanks to all CCSBT members, my colleagues in Japan, and everyone here and especially to Ray who invited me to the UW and Jim who invited me to the baseball game.

If you have any questions, I'd be happy to answer them now. Thank you very much.
(no more click)
