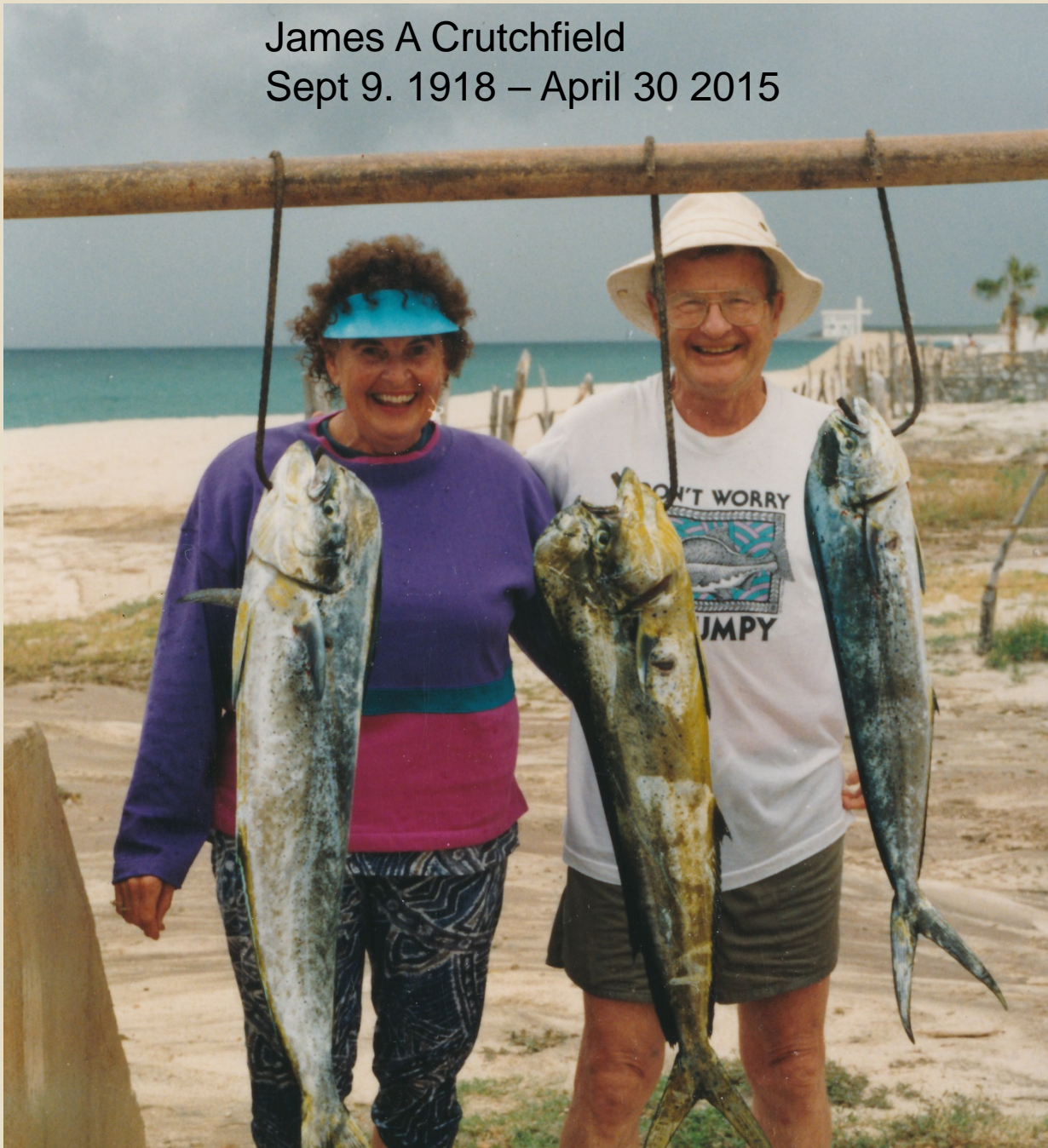Ecosystem Based Fisheries Management
A National Standard 1 Guideline Perspective

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Keynote Address
NAAFE Forum 2015
May 20–22, 2015
University of Alaska Southeast
Ketchikan, Alaska

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Sept 9. 1918 – April 30 2015

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Take Home Message

There is a frustration with the lack of focus on Ecosystem Based Fisheries Management (EBFM).

> What exactly is it?
> How can it be implemented?

The NS 1 Guidelines provides the basic protocol used to implement single species fisheries management in the US. Further the principles in these guidelines are used throughout the world.

I *suggest* these guidelines provide a useful template for ***thinking*** about developing a protocol for implementing EBFM.

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There is a frustration with the lack of focus on Ecosystem Based Fisheries Management (EBFM).

What exactly is it?
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I suggest these guidelines provide a useful template for *thinking* about developing a protocol for implementing EBFM.

if it is practical to increase the dimensionality of current process,

and if we allow for some changes in the law.

And even if it can't be done the exercise of thinking about it will be illuminating.

Important concepts of NS1 Guidelines

Stocks in the fishery/ecosystem component

Target stock size
Limit stock size
Overfished

Control Rule
OFL/ABC buffer
Overfishing

Important concepts of NS1 Guidelines

Stocks in the fishery/ecosystem component

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Control Rule
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Overfishing

1.Can we find analogous concepts for EBFM that capture ways to address tradeoffs?
2. Can we talk about them in terms of a bioeconomic model and also in NS1 language?

Outline

1. Broadly speaking what is fisheries management and how and where do NS1 concepts fit into it.

2. What are the basic concepts of NS1 management and how are they addressed in single species management?

3. Can the procedure used in single species management be applied/adapted to EBFM?

1.Broadly speaking what is fisheries management and how and where do NS1 concepts fit into it?

Paraphrasing from several FAO documents

Fisheries management is the

integrated process of information gathering, analysis, planning, decision-making, allocation of resources and formulation and enforcement of fishery regulations

Institutional Structure

by which the fisheries management authority controls the present and future behaviors of the interested parties in the fishery,

Regulation

so as to optimize the use of fishery resources as a source of human livelihood, food and recreation while ensuring the continued productivity of the living resources.

NS #1

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NS #1

All parts are critical but discussion here will focus on necessary changes in terms of the NS1 structure.

Paraphrasing from several FAO documents

Fisheries management is the

integrated process of information gathering, analysis, planning, decision-making, allocation of resources and formulation and enforcement of fishery regulations

Institutional Structure

by which the fisheries management authority con | The key is to determine what to change and what *behaviors of the interested parties in the fishery,* | can be left alone.

Regulation

so as to optimize the use of fishery resources as a source of human livelihood, food and recreation while ensuring the continued productivity of the living resources.

NS #1

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2. What are the basic concepts of NS1 management and how are they addressed in single species management?

NS1

The primary function of fisheries management is the determination of the annual allowable harvest, and it is based on *predetermined* target stock size and a *predetermined* control rule to choose a harvest path that that will cause the target stock size to be achieved or maintained.

Tension between flexibility and control rules.

Target stock and control rules are predetermined so as to avoid making decisions in haste and to avoid short term political pressure.

But some flexibility *within* control rules and with respect of changing targets and control rules is necessary to avoid getting caught up in red tape.

Prudent flexibility will be necessary for success in EBFM because of the necessity to address tradeoffs.

The selection of the target stock and the control rule for harvest path are conceptually policy decisions. Ideally they are selected to achieve "optimal yield" that is to maximize the net benefits to current and future users.

Sustainable Catch

Limit Stock   Target Stock   Max Stock
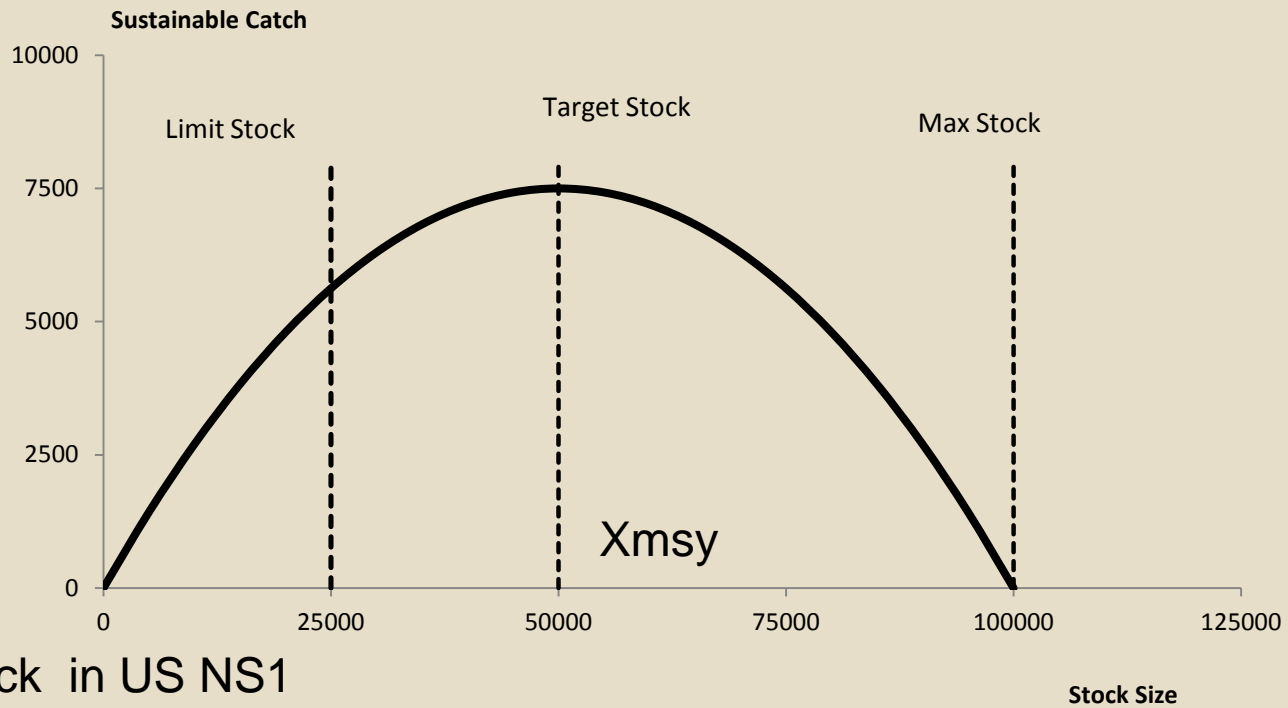
Xmsy

Stock Size

Target stock in US NS1

The benefits to society will change with changes in stock size due to changes in sustainable yield. Presumably welfare will be maximized at *Xmsy.*

This does give us something to shoot for and a basis for a control rule to set annual harvests.
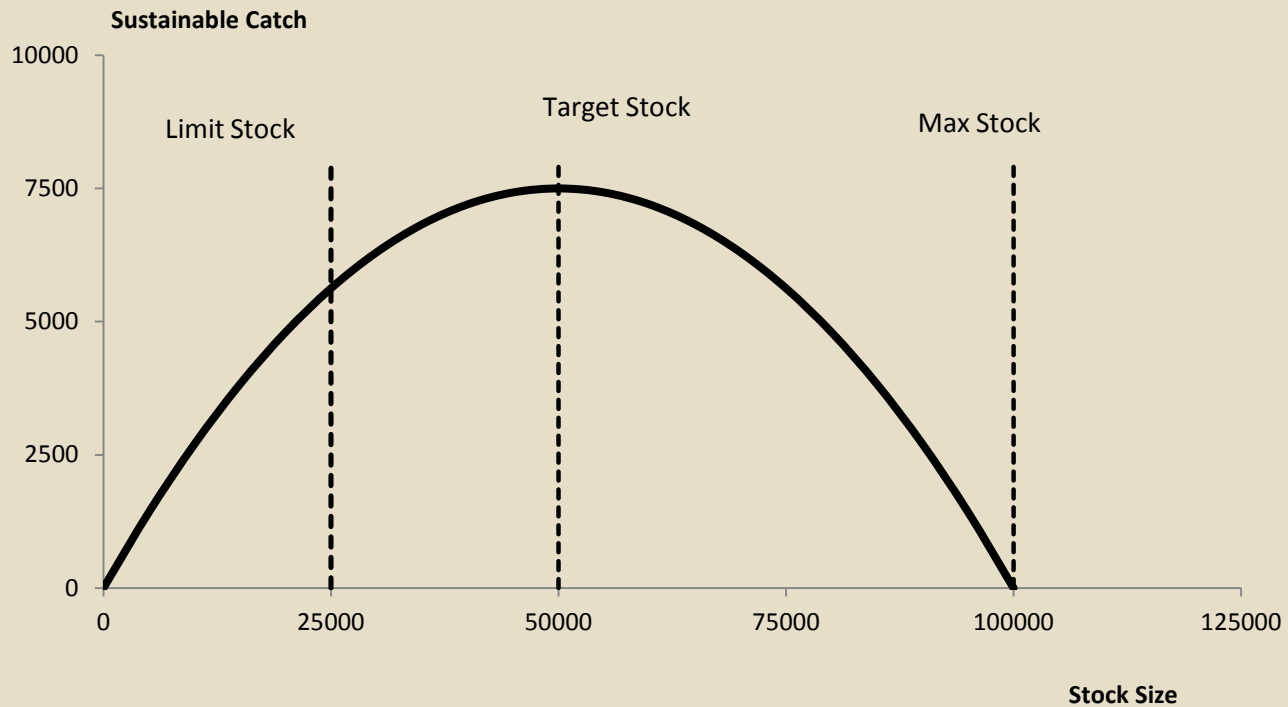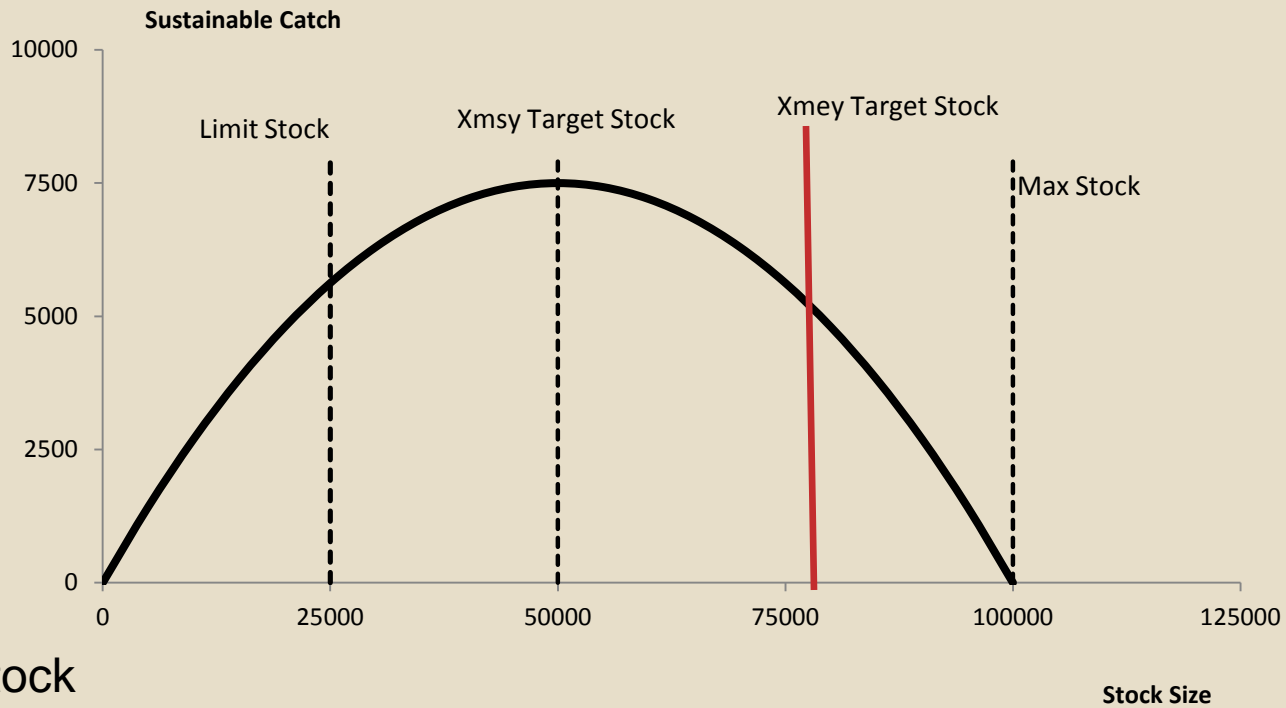
Conceptually do we have the right target?

Do we have enough information to determine the actual Xmsy?
    Use of proxies

We have a moving target.
Changes in harvest technology will change Xmsy.
Changes in conditions or information of conditions will change Xmsy.

Sustainable Catch

Limit Stock — Xmsy Target Stock — Xmey Target Stock — Max Stock

Stock Size

Target stock

Xmey could be a target stock size but that would require other conditions. The sustainable catch would have to be harvested a the lowest cost.

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In the US, the policy decision on target stock has been made by legislation and the policy decision on harvest paths is in the hands of the councils subject to restrictions in the law other guidelines.
Why?

1. Naïve view of benefits

    Target stock and harvest path based on maximization of biomass yield or minimum time growth path

2. There is considerable distrust for the for management councils within some green groups and within the legislative process.

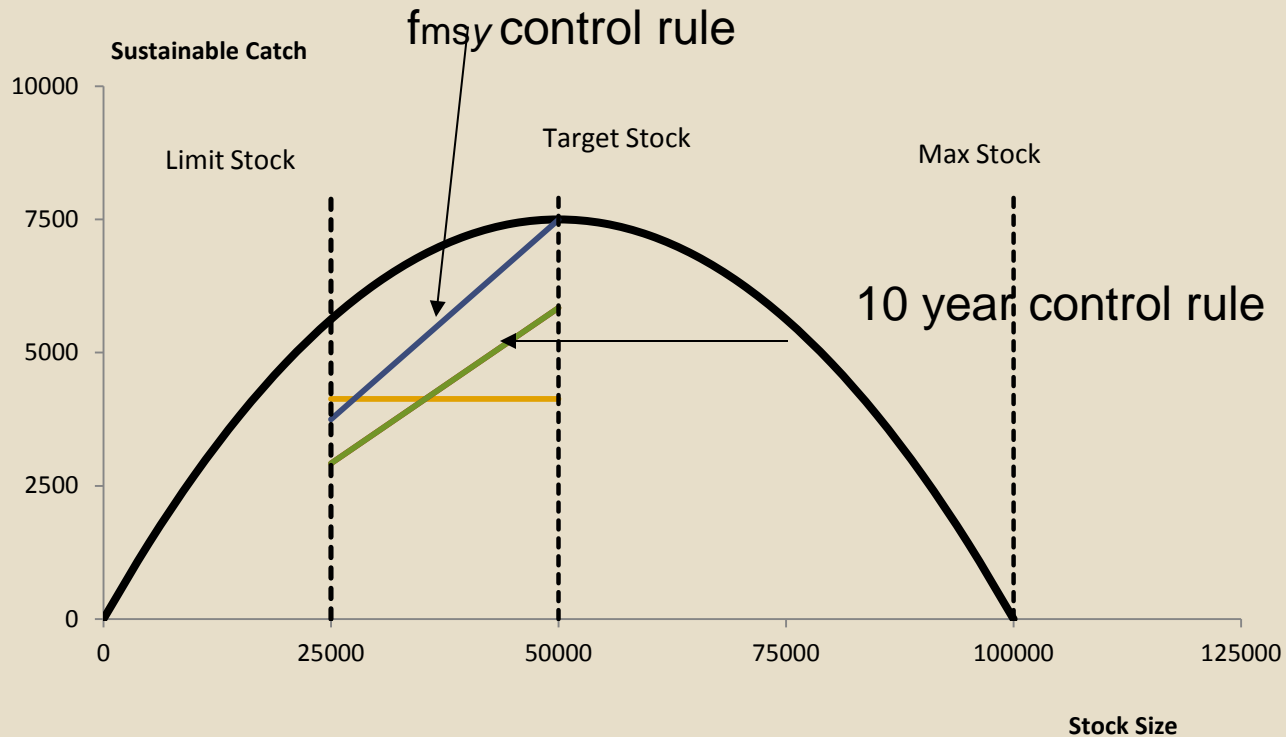Consider the political process that goes into establishing NS1 Guidelines language.

Sustainable Catch

Limit Stock   Target Stock   Max Stock

Stock Size
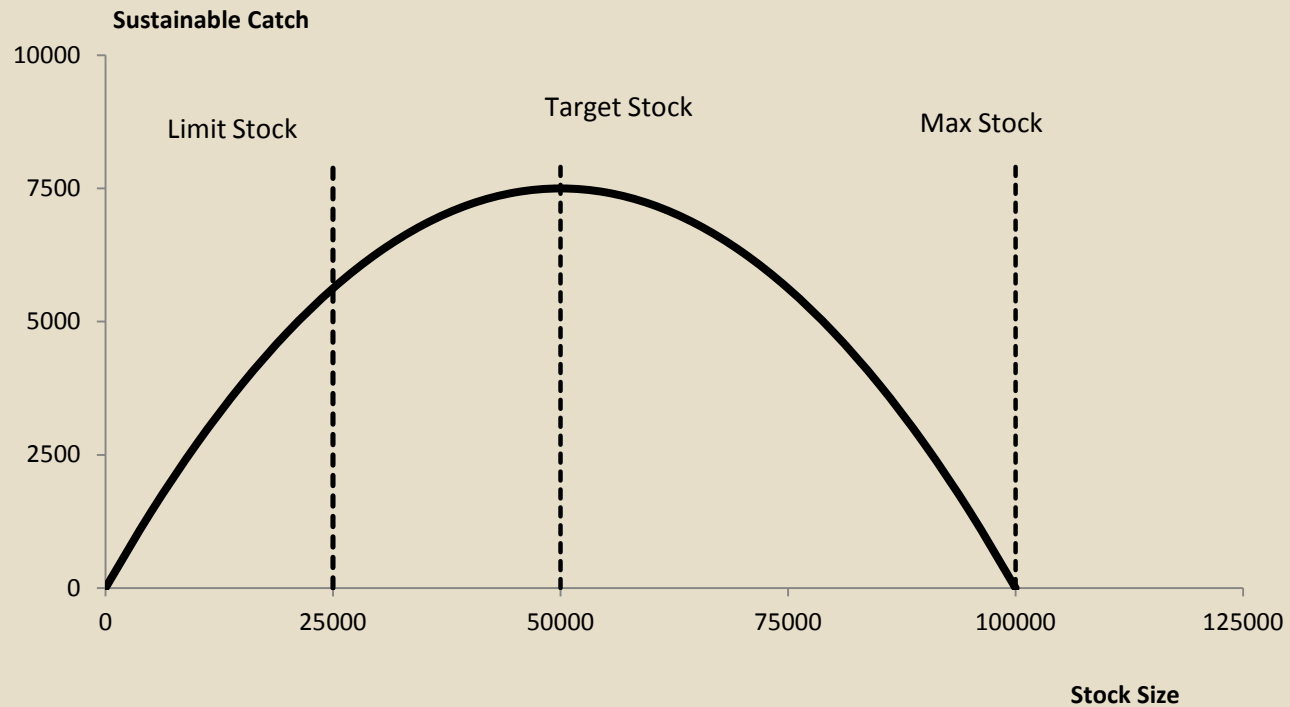
Practical council policy application

Given stochaisticity, limited data etc, the FAO Precautionary Principle advises us to just keep moving toward target.
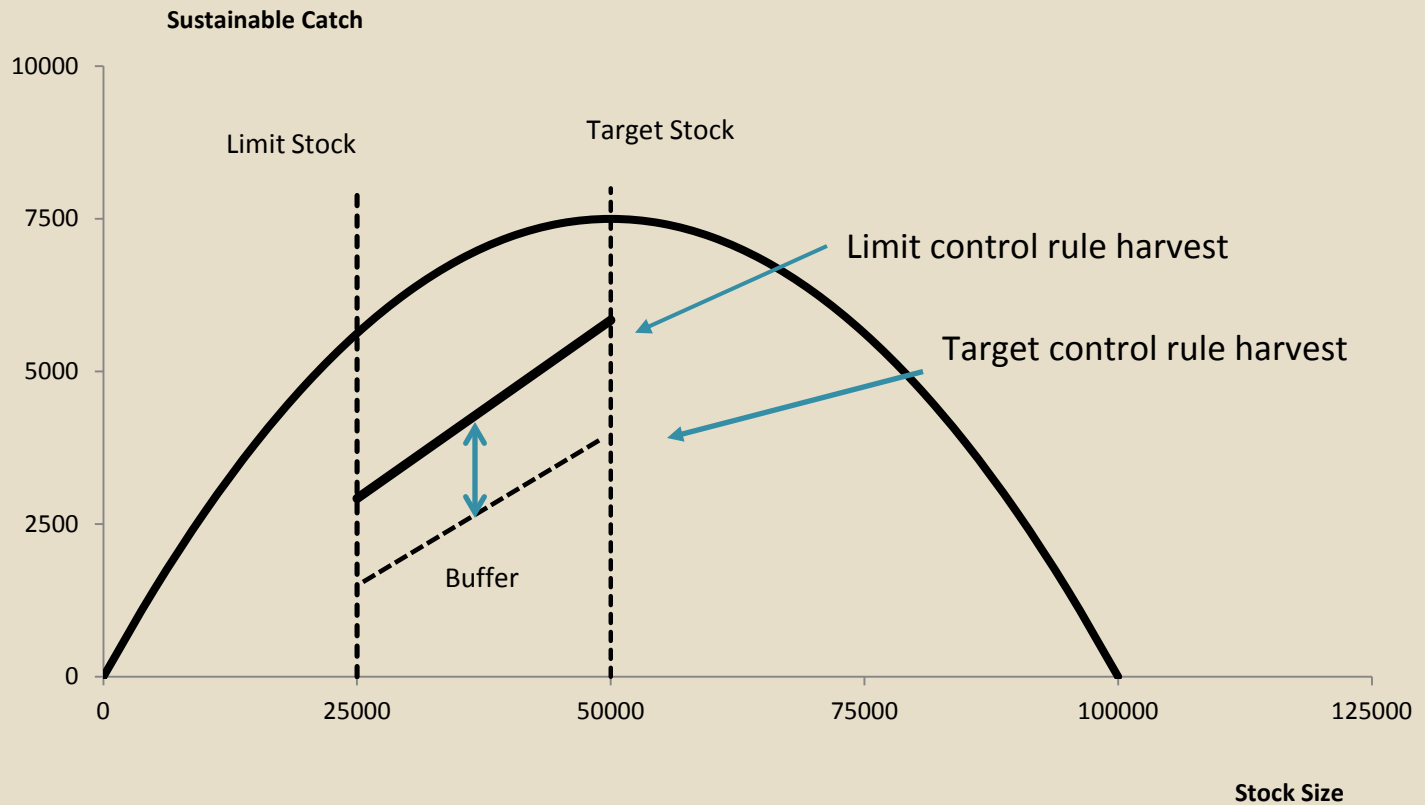
Close counts

Limit stock
But there are limits

Sustainable Catch

f$_{msy}$ control rule

Target Stock

Limit Stock

Max Stock

10 year control rule

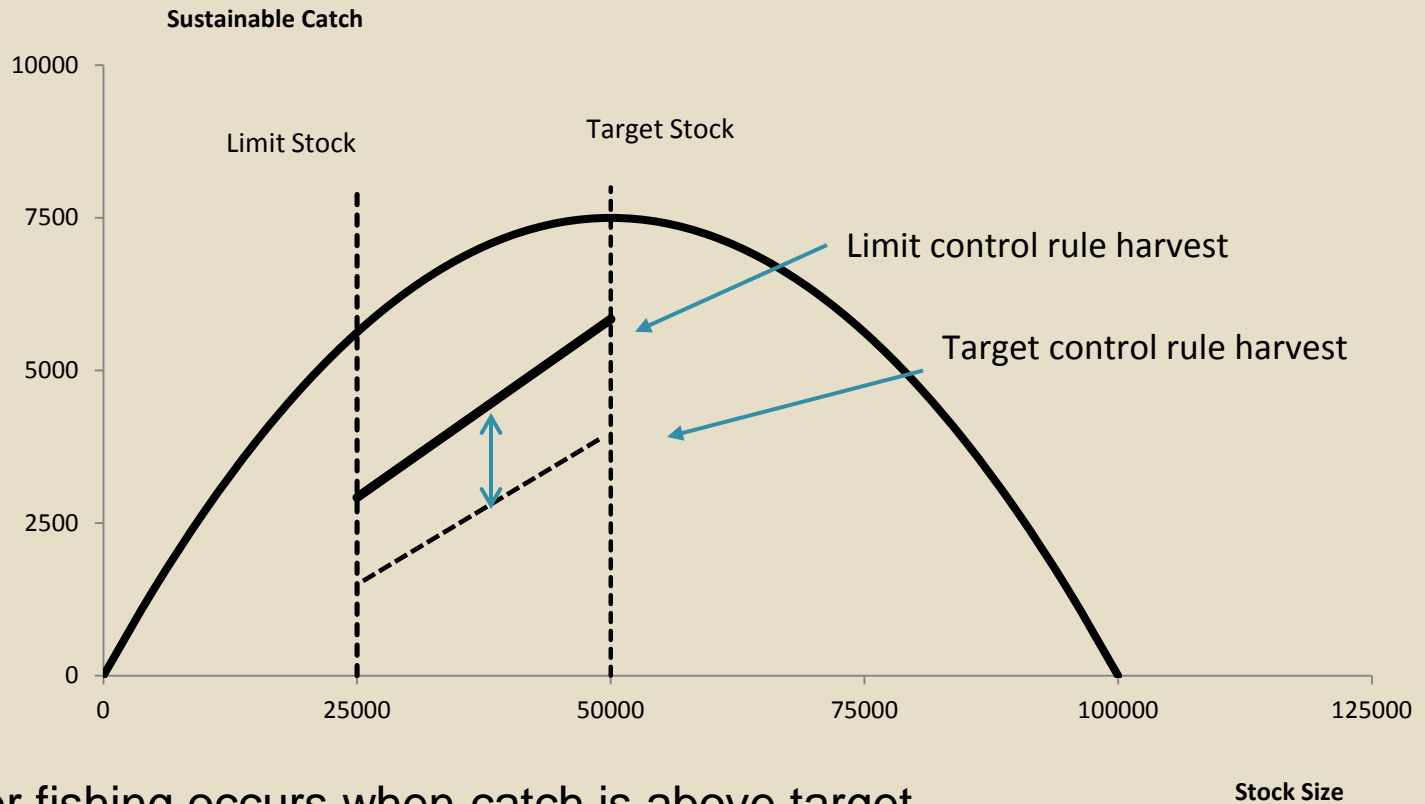**Stock Size**

Control Rules

Keep us on path to get to target stock
Infinite number to choose from
Choice of Path will affect benefits

Overfishing

Control rule sets an upper limit on harvest.

On an annual basis, we shoot for target harvest level so as to not go over limit. This is the infamous buffer problem.

Sustainable Catch

Limit Stock

Target Stock

Limit control rule harvest

Target control rule harvest

Stock Size

Over fishing occurs when catch is above target.

But it is important to note using either definition it is possible to have overfishing when stock size is going up.

The term overfishing can be somewhat of a misnomer.
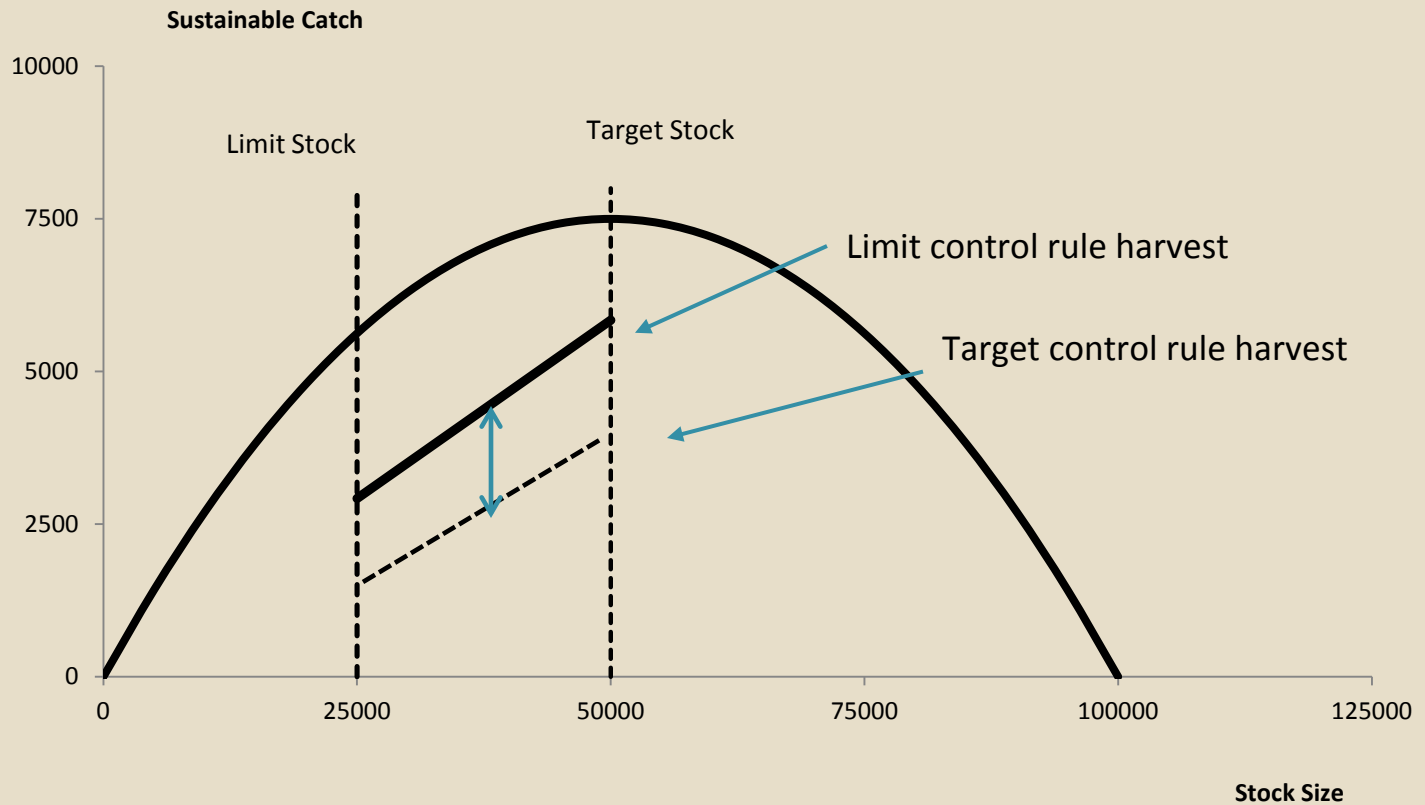
Current process does not allow for consideration of opportunity costs (trade offs). We are giving certain current catch for possible increase in future catch with no formal benefit cost analysis.

NS1 Guidelines are, for the most part, conceptually sound, but they are somewhat incomplete and ad hoc in actual implementation.

To use these principles as a framework does not mean we have to shoot for perfection.

NS1 Single Species

Ignorance

Perfection
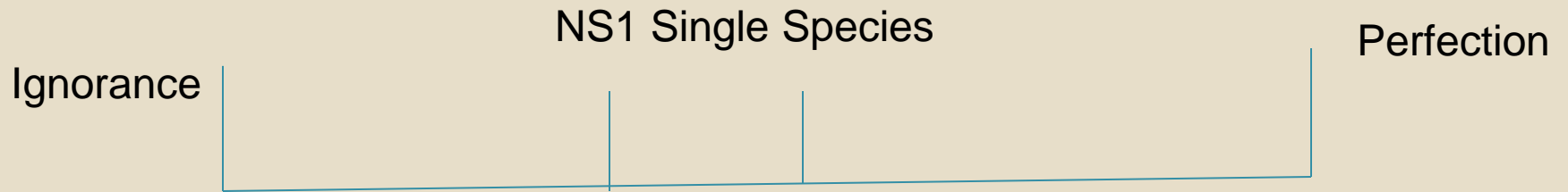
Where are we in NS1 single species management?

3. Can the NS1 procedure used in single species management be applied/adapted to EBFM?

What is EBFM?

Many definitions.

I am not trying to be cynical but I want something helps me think in operational terms.

The term has been defined (US National Research Council, 1998) as "an approach that takes major ecosystem components and services - both structural and functional - into account in managing fisheries... It values habitat, embraces a multispecies perspective, and is committed to understanding ecosystem processes... Its goal is to rebuild and sustain populations, species, biological communities and marine ecosystems at high levels of productivity and biological diversity so as not to jeopardize a wide range of goods and services from marine ecosystems while providing food, revenues and recreation for humans.

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This is all true but this is only about what it does, but not what it is nor how to do it.

EBFM (is) a process that moves from traditional fisheries management toward a broader consideration of ecosystem and socioeconomic information. Specific criteria focus on movements to stop overfishing, delineate ecosystem interactions, quantify and address uncertainties, set goals and indicators for ecosystem health, develop and apply ecosystem models and management tools

Something like a target stock size but not quite.

Is welfare directly related to size of indicators?
Does the indicator provide the basis for the control rule.

NOAA Fisheries defines EBFM in the following manner: "Ecosystem-based fishery management recognizes the physical, biological, economic and social interactions among the affected components of the ecosystem and attempts to manage fisheries to achieve a stipulated spectrum of societal goals, some of which may be in competition" (Osgood 2013).

Osgood, K. 2013. Ecosystem-based fishery management: Council member training. October 23, 2013,

Some in NOAA have defined EBFM in the following manner:

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Takes cognizance of a maximand and of the necessity of trade offs.

But can we do this under current NS1 Guidelines?

In the presentation he makes the commonly made distinction between

Ecosystem Approaches to Fisheries Management (EAFM)

– Develop reference points (e.g. overfishing limits, population targets and thresholds) that are calculated with inclusion of ecosystem considerations - e.g. inclusion of predation, environmental or habitat variables into stock assessments

Ecosystem Based Fishery Management (EBFM)

– Develop reference points at the ecosystem level - e.g. ecosystem productivity thresholds, habitat thresholds
– Area and seasonal closures, gear restrictions to protect sensitive areas, species, or life stages

Ecosystem Approaches to Fisheries Management (EAFM)

– Develop reference points (e.g. overfishing limits, population targets and thresholds) that are calculated with inclusion of ecosystem considerations - e.g. inclusion of predation, environmental or habitat variables into stock assessments

This can be handled as a slight modification of NS1

(EAFM)

The ecosystem approach to fisheries management is the determination of the annual allowable harvest of a single stock, and it is based on the selection of a target stock range and the range of harvest paths that that will cause the stock to achieve or maintain its target stock range.

The target stock range and the harvest path range are determined taking into account ecosystem information including   predation, climate and oceanographic effects on recruitment, natural morality, stock distribution, etc. into the stock assessments process and the short run stock growth estimation procedure.

We are doing this already in some cases where covariates are introduced into the stock assessments.

Target stock Range

Sustainable Catch

High

Med

Low

High

Med

Low

Stock size

40
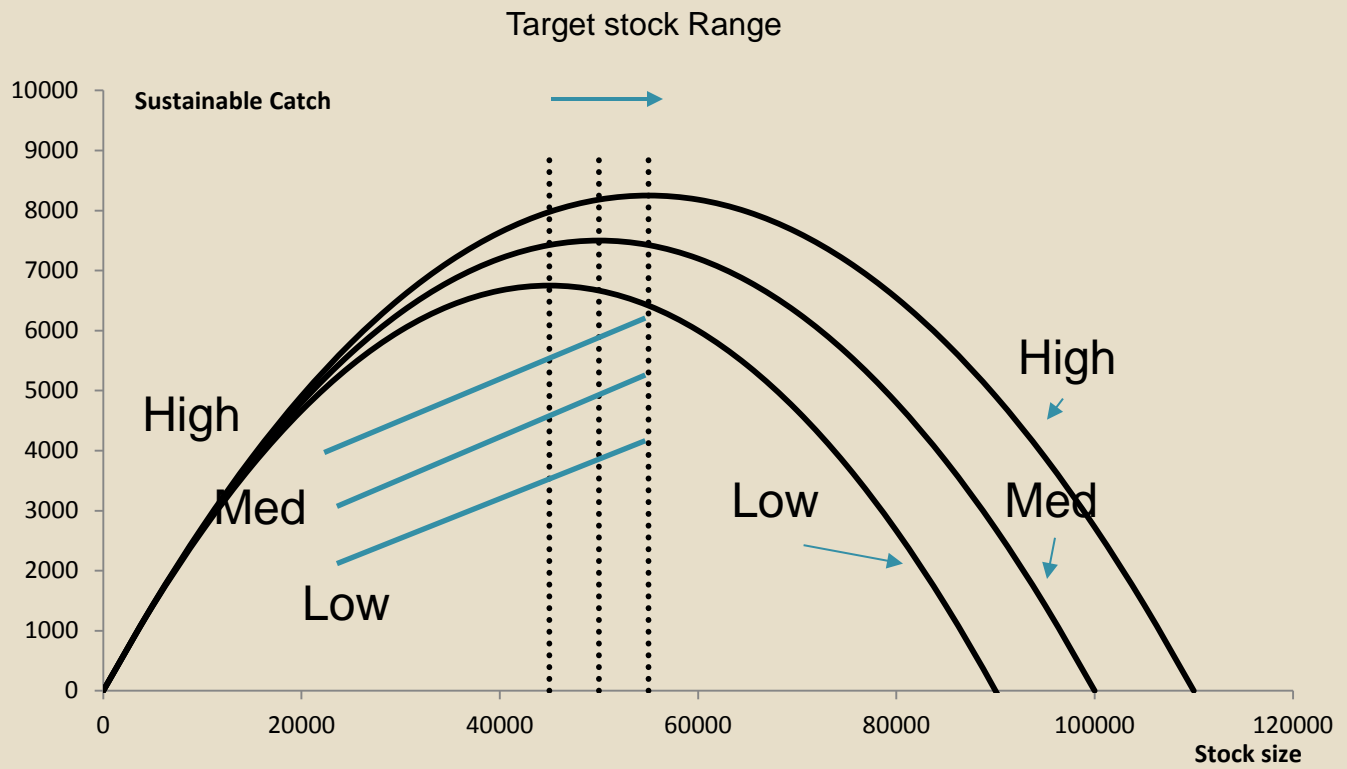
This is one way to envision this.

Not really a big change. Can we do it now?

Stock targets to target ranges
Control rules to range of control rule.

What will the current revision of NS1 guidelines actually say on this?

Ecosystem Based Fisheries Management (EBFM)

- Develop reference points at the ecosystem level - e.g. ecosystem productivity thresholds, habitat thresholds

– Area and seasonal closures, gear restrictions to protect sensitive areas, species, or life stages

Important concepts of NS1 Guidelines

Stocks in the fishery/ecosystem component

Target stock size
Limit stock size
Overfished

Control Rule
OFL/ABC buffer
Overfishing

Can we find analogous concepts for EBFM that allow for the consideration of tradeoffs.

STATUS QUO
The primary function of fisheries management is the determination of the annual allowable harvest, and it is based on the selection of a target stock size and a control rule to determine the harvest path that that will cause the target stock size to be achieved or maintained

EBFM
Ecosystem based fisheries management (EBFM) is the *simultaneous* determination of allowable harvest levels for a specified group of stocks (a vector of harvest levels) and it is based on selection of a target stock space and a control rule to determine the time path of the harvest vector that will cause the vector of current stocks sizes to move into or remain in the target stock space.

In principle both the target stock space and the control rule should be chosen so as to maximize the net benefits to current and future users, defined in a manner that is compatible with the concept of Optimal Yield.

The *predetermined* selection of the list of groups of stocks to consider and the stocks or stock complexes of which specific species belong in each group is one of the most important decision variables of the EBFM problem and should depend upon the full range of social, ecological, environmental, and technical harvest relationships between stocks.

It will be necessary to know the ecological and economic relationships between the stocks and how people use and value the sustainable outputs of the various stock combinations. There are many complex layers involved.

For example, while two stocks may be fairly close ecological substitutes in the sense that they both can live in the same habitat and can survive on the same amount of primary productivity they may provide vastly different services to users.

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For example, while two stocks may be fairly close ecological substitutes in the sense that they both can live in the same habitat and can survive on the same amount of primary productivity they may provide vastly different services to users.

These types of discussions are necessary precursors to implementation of EBFM

Target stock space in two dimensions
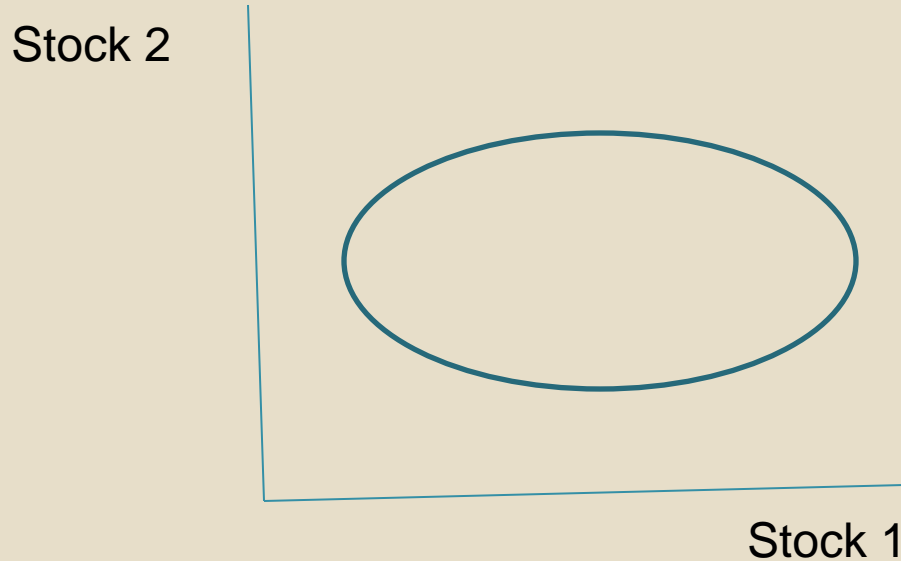
The equivalent of the target stock size is the *target stock space*. We need more than a simple set of independent scalar stock sizes.

It may be okay to have a less of one stock if we have more of the others that provide similar social or ecological services

Stock 2

Stock 1

Target stock space in two dimensions
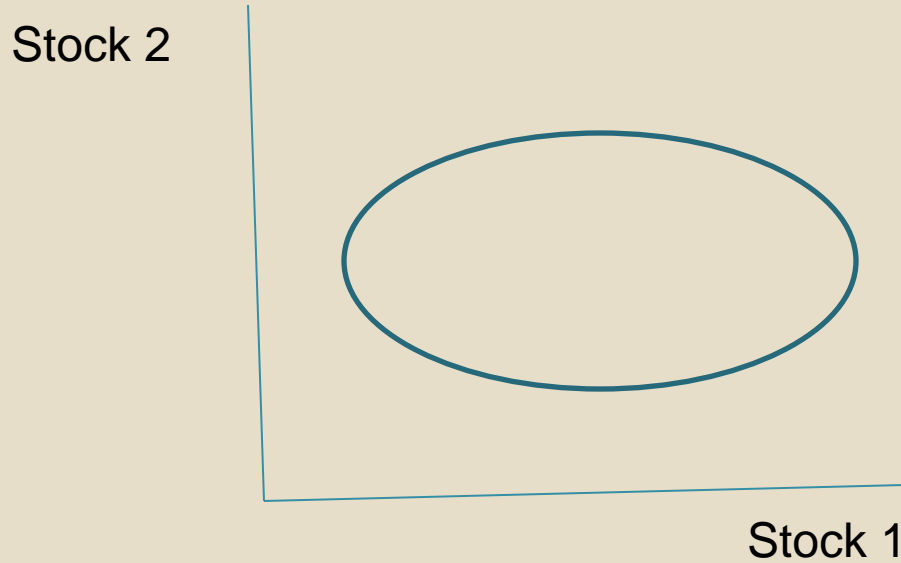
Stock 2

Given the non-comparability of the values or possible benefits from the use of the outputs of the various stocks, it will be necessary to go beyond the concept of the maximization of sustainable biomass yield as a measure of benefits.

Stock 1
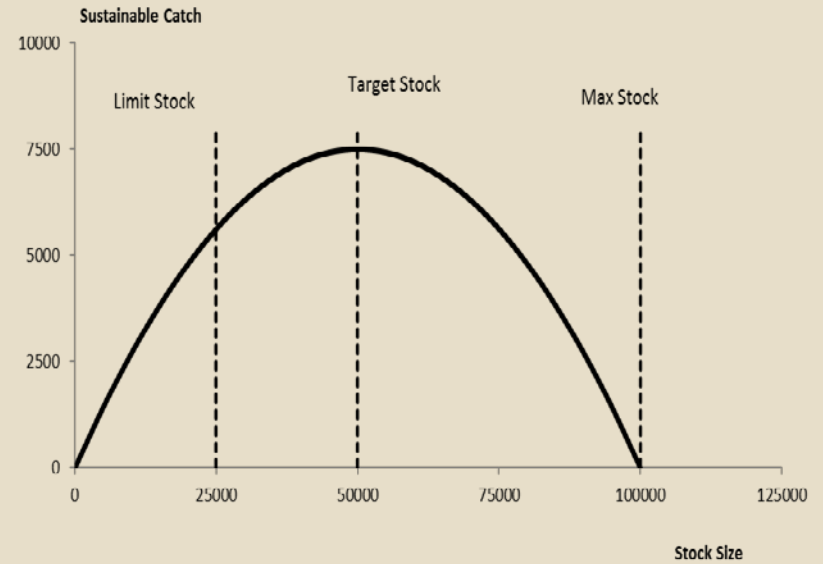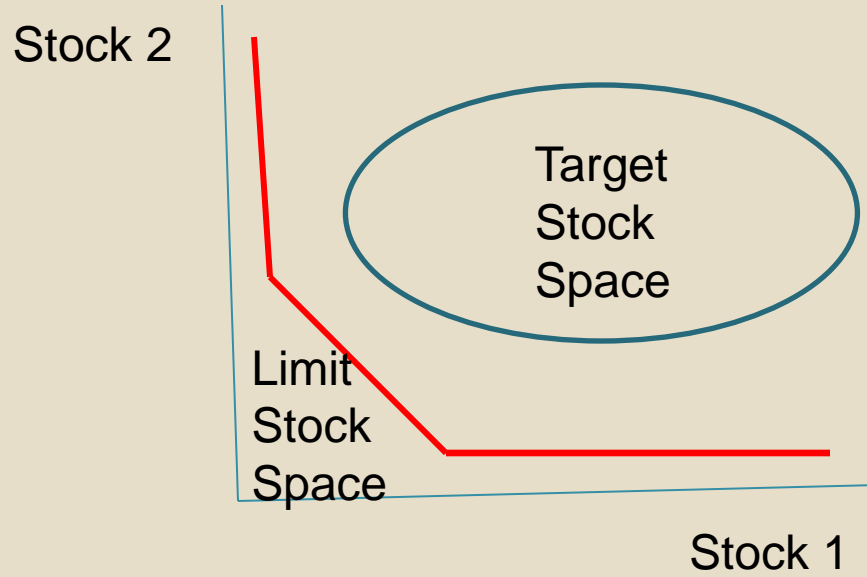
Target stock space
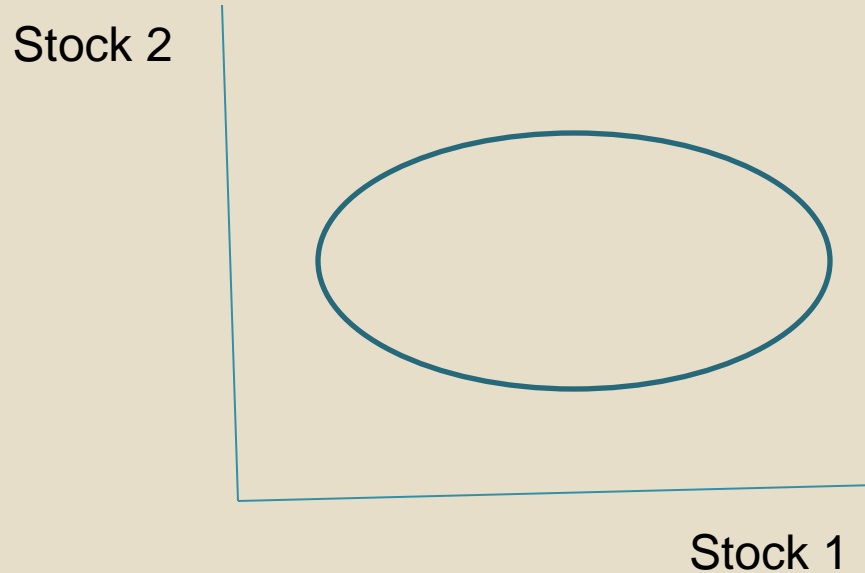
Stock 2

Stock 1

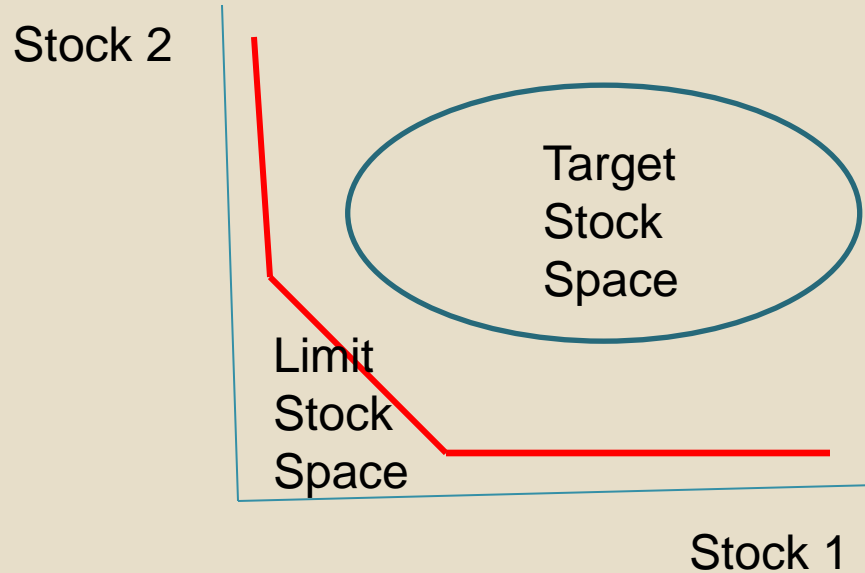What is measured on the third dimension. What other constraints have to be imposed.

This has to be *predetermined* and will be a necessary prerequisite of implementing EBFM.

The determination of target stock space requires a clear statement of objectives and acceptable tradeoffs.

Limit stock space

Stock 2

Target Stock Space

Limit Stock Space

Stock 1

Limit stock space

Over a certain range stocks can be substitutes for each other.

What is measured on the third dimension.

This has to be predetermined and will be a necessary prerequisite of implementing EBFM.

The determination of limit stock space requires a clear statement of objectives and acceptable tradeoffs.

Stock 2

Target
Stock
Space

Limit
Stock
Space

Stock 1

A key concept is the simultaneous determination of a set of allowable annual harvests. In addition to possible ecological and environmental variables, the annual allowable harvest level of any one stock will depend upon its own stock size and characteristics and on the size, characteristics and annual harvest level of one or more of the other stocks in the group.. If the allowable harvest levels of different stocks are functions only of their own stock size and characteristics and are independent of the allowable harvests of other stocks we are back to independent stock management with EAFM.

The annual harvest level for a subset of the stocks may be low or equal to zero especially in the case of forage species

Multi-demensional Control rule

The question of question of finding the best path from the status quo to somewhere in the target stock space is both a social and an ecological question. (It also raises the possibility of choosing between different spots in the target stock space.) The path is important because the amount of benefits that will be produced for the users will depend upon what can or cannot be harvested along the harvest path as well as on the expected final location in the target stock space.

Should there be limits on the general direction of the path?

What is Overfishing?

A path outside the light blue arc?

A path outside the red arc?

Target stock space

Status Quo

Remember we will be working in n-dimensional space
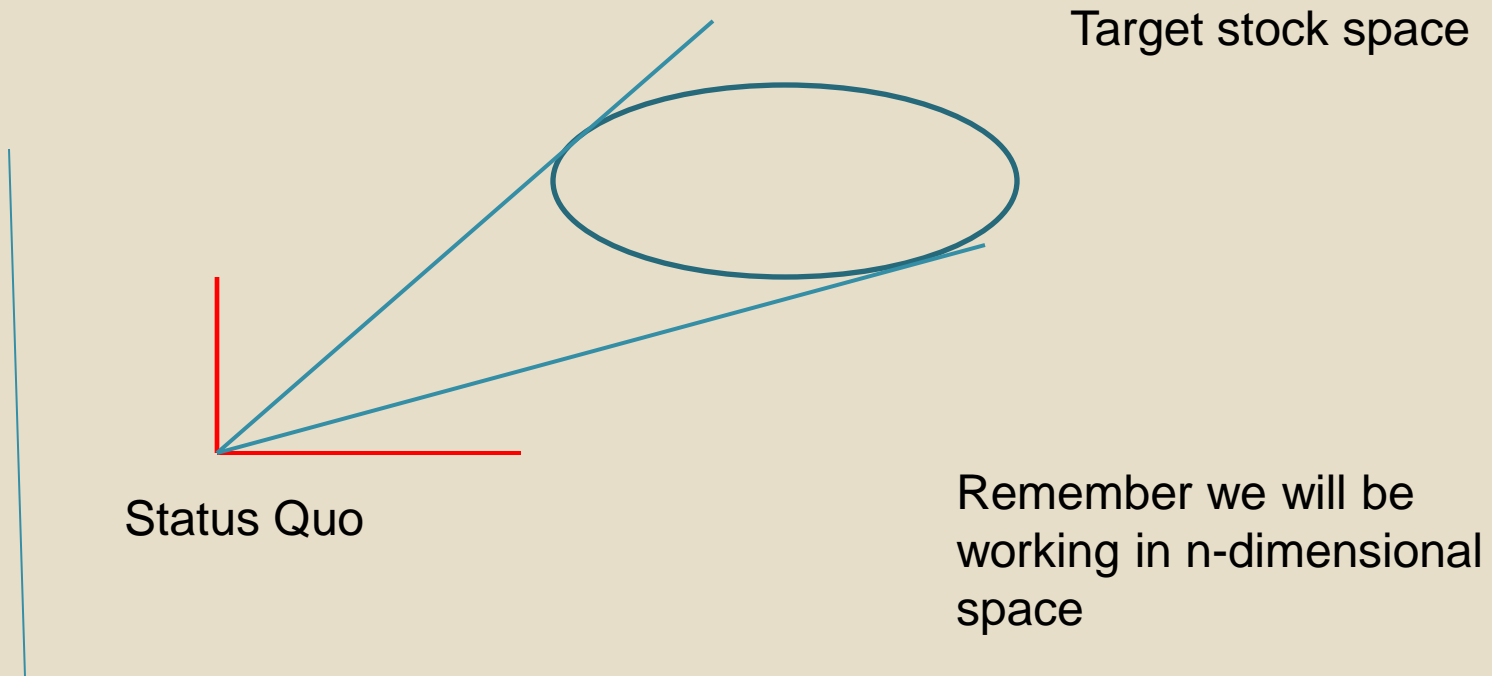
How do you handle the concept of a buffer in this context?

Stop all the hand waving and talking about what EBFM is and what is does. Let's talk about how to do it at the NS1 Guideline level.

I am not claiming to know how to do it. I am just laying out some of the issues that in my opinion need to be addressed.

Important concepts of NS1 Guidelines

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1. Can we find analogous concepts for EBFM that capture ways to address tradeoffs?
2. Can we talk about them in terms of a bioeconomic model and also in NS1 language.

First steps

Metric of success. What is measured on 3rd (n+1) axis?

Are indicators related to the metric of success? Do they provide a basis for a control rule.

Clear statement of management objectives and permissible tradeoffs

Selection of stock groupings.
Stock target space
Stock limit space

Lot of work for council, and council and NMFS staff in a well defined and transparent process seeking prudent amount of flexibility.

Legislative changes?

Ignorance

EBFM

NS1 Single Species

Perfect