



Catch Allocation in a Shared Fishery with a Minimally Managed Recreational Sector*

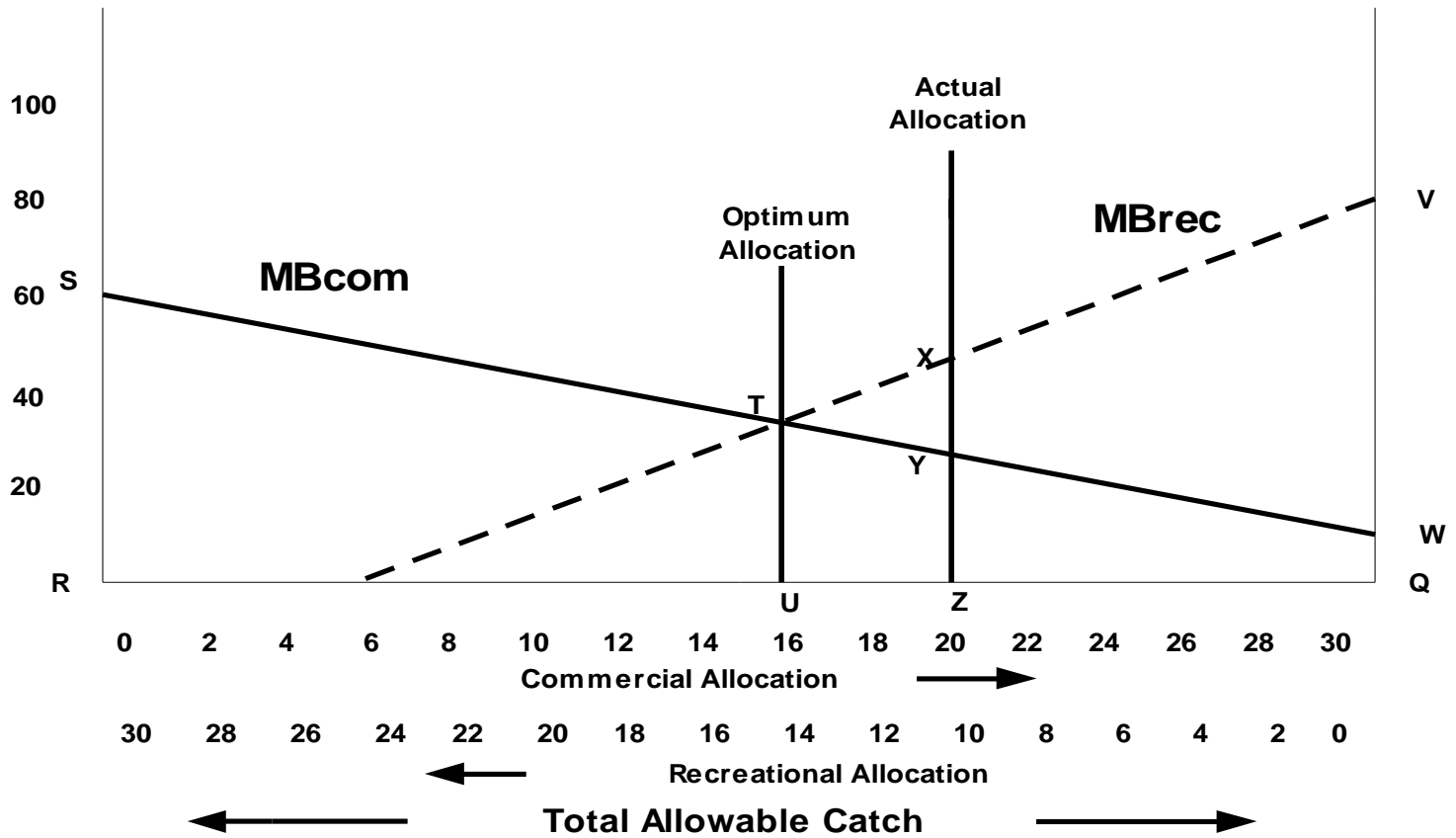
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* The authors acknowledge financial support from the NZ Ministry of Fisheries

Conventional analysis of catch allocation in a shared fishery

Marginal Net Benefits (\$/kg)



Asymmetric management in many shared fisheries

- Commercial and recreational fishers share a fish stock
- Commercial sector usually well managed, BUT
- Politically very difficult to limit entry and/or limit the size of the recreational catch, so typically recreational fisheries are minimally managed and open access
 - No limit on numbers of recreational fishers
 - Often no requirement to hold a fishing licence
 - No property rights
- Recreational effort & catch essentially self regulating

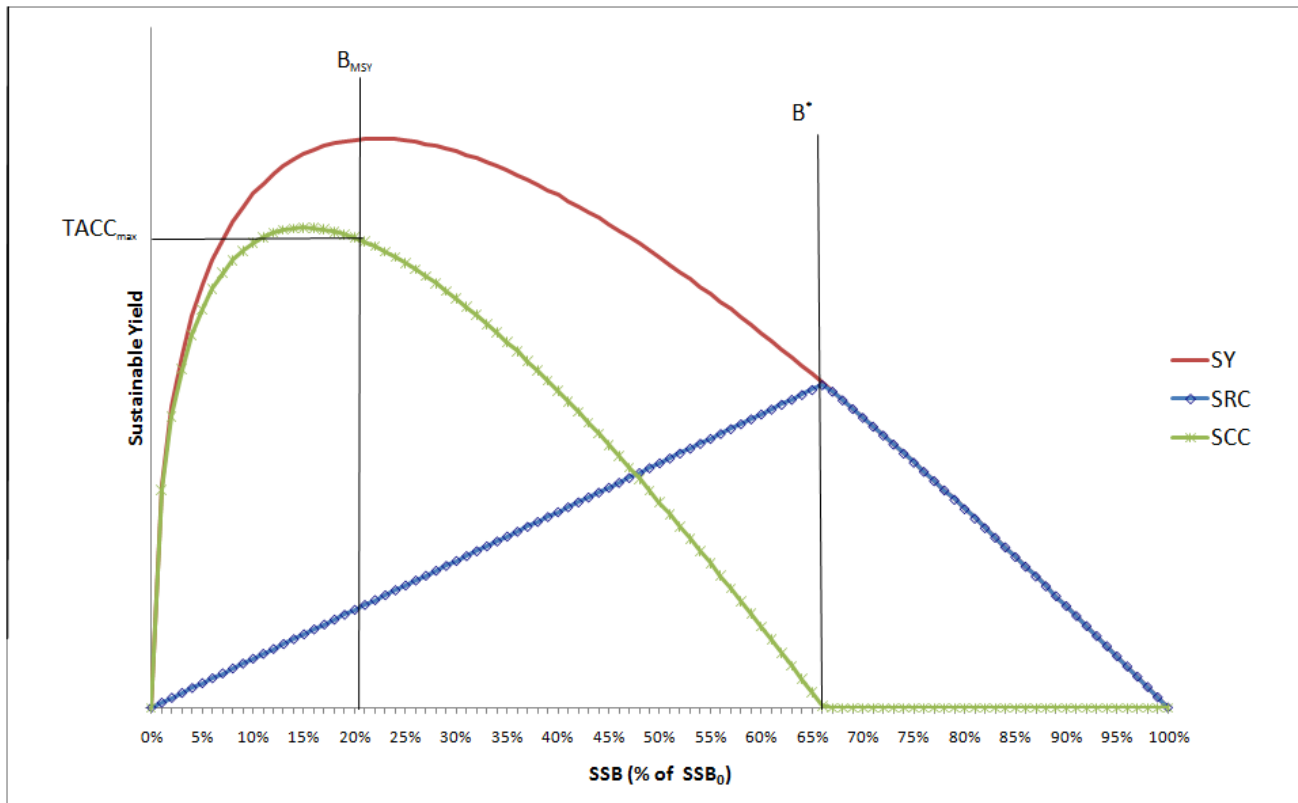
Problems

- If can effectively regulate catch size of BOTH sectors
 - total allowable commercial catch (TACC)
 - total allowable recreational catch (TARC)
 - then can re-allocate TAC to or away from recreational fishing sector
- If no control on TARC, then can only indirectly re-allocate catch from commercial to recreational fishing (& vice versa)
 - consequence of reduced TACC will be increase in stock abundance
 - in minimally managed recreational fisheries, essential to understand fishers response to extra stock abundance
 - impact of reduced TACC on increase in stock abundance may be partially offset if recreational fishers increase catch

New Zealand catch allocation process

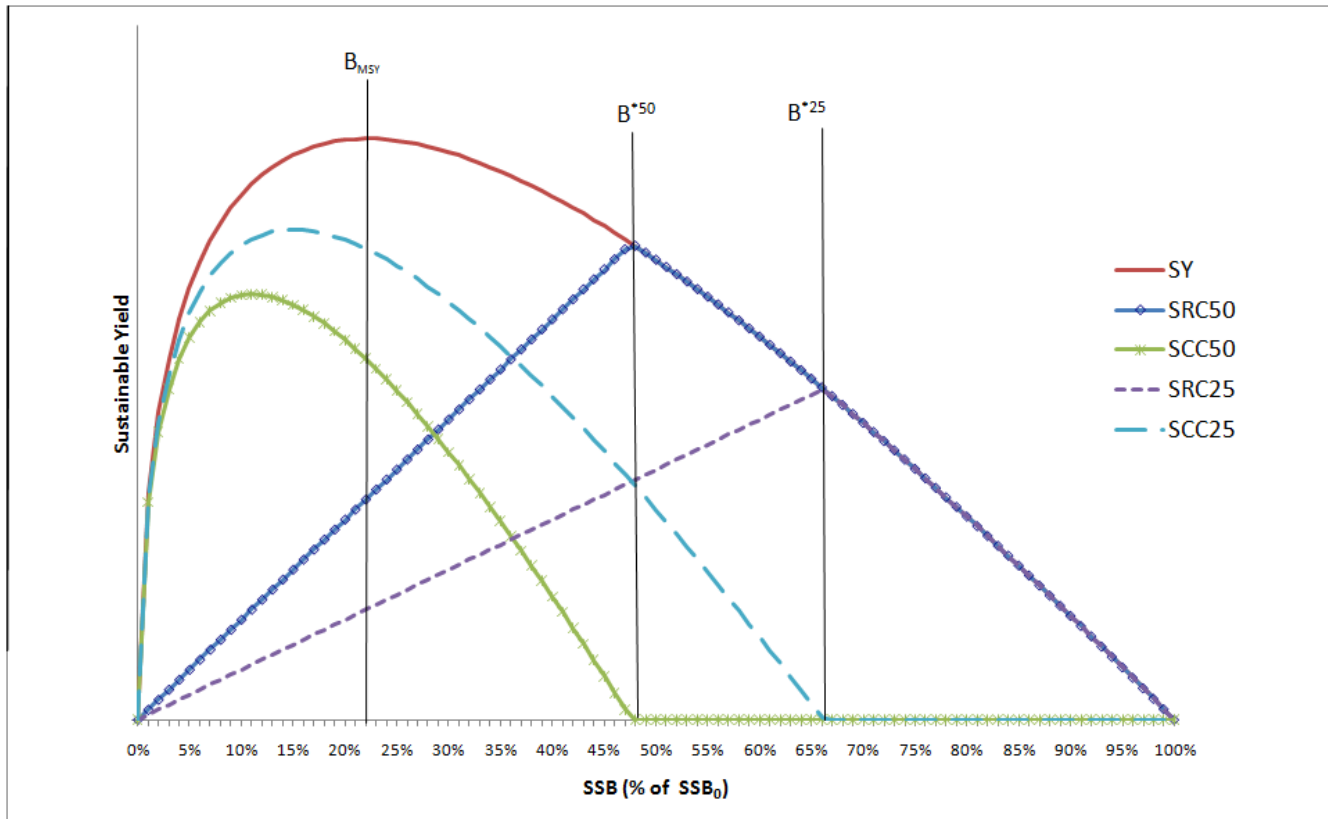
- For given spawning stock biomass (SSB), determine fishery sustainable yield (SY) and hence total allowable catch (TAC) on sustainability grounds
- Estimate self regulated size of non-commercial (recreational + customary) catch (NCC) for given SSB
- Set total allowable commercial catch (TACC), then let SSB and NCC adjust until $SY = TACC + NCC$
- Question: if $TAC = \text{maximum sustainable yield (MSY)}$, will the total value of combined catch be maximised?

Basic biological model



- $SY = TAC$
- SRC = sustainable recreational catch
- SCC = sustainable commercial catch
- Sustainable TACC = $TACC_{MSY} > TACC > 0$
- Sustainable SSB = $B_{MSY} < SSB < B^*$

Impact of RC coefficient, ϕ , on sustainable range of TACC

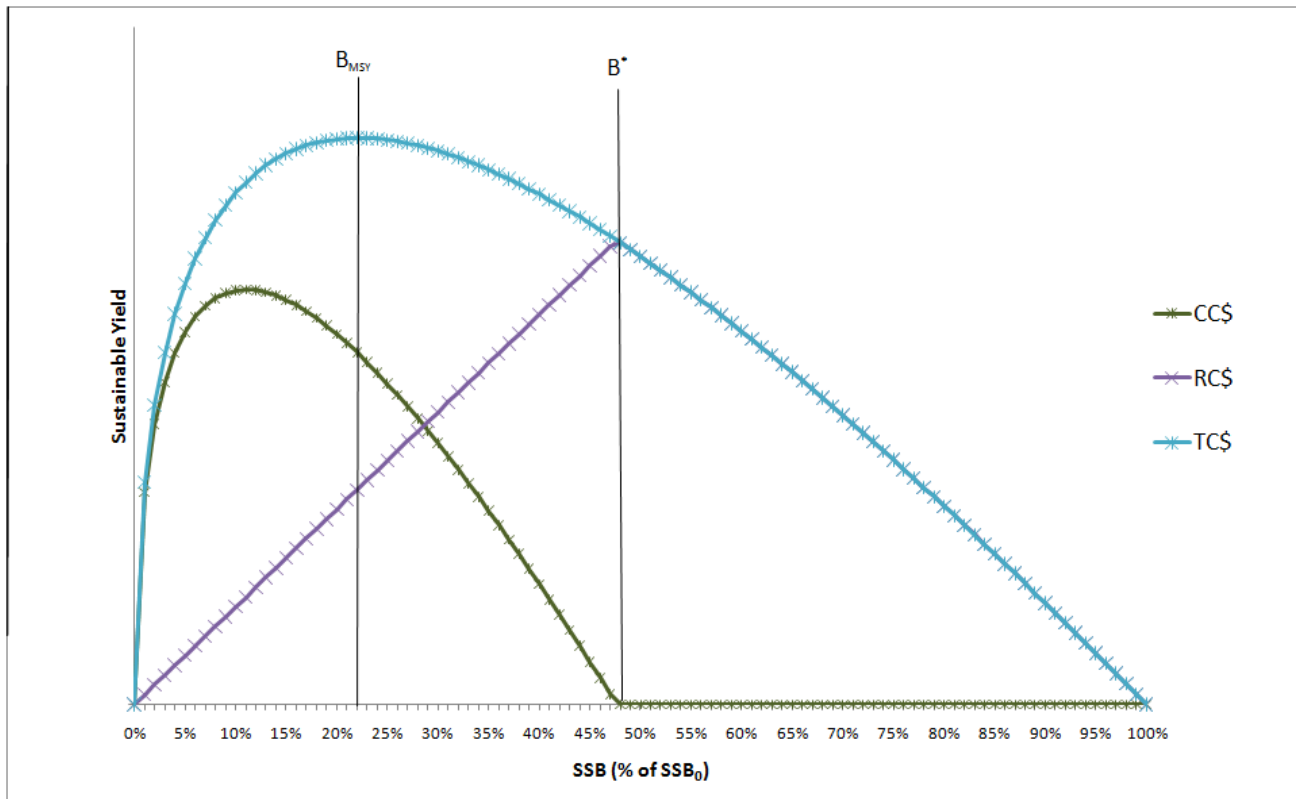


- $RC = \phi * SSB$
- Larger ϕ = smaller B^*
- Larger ϕ = smaller TACC at any SSB
- No change to lower bound of sustainable SSB

Preliminary questions for managers of a shared fishery

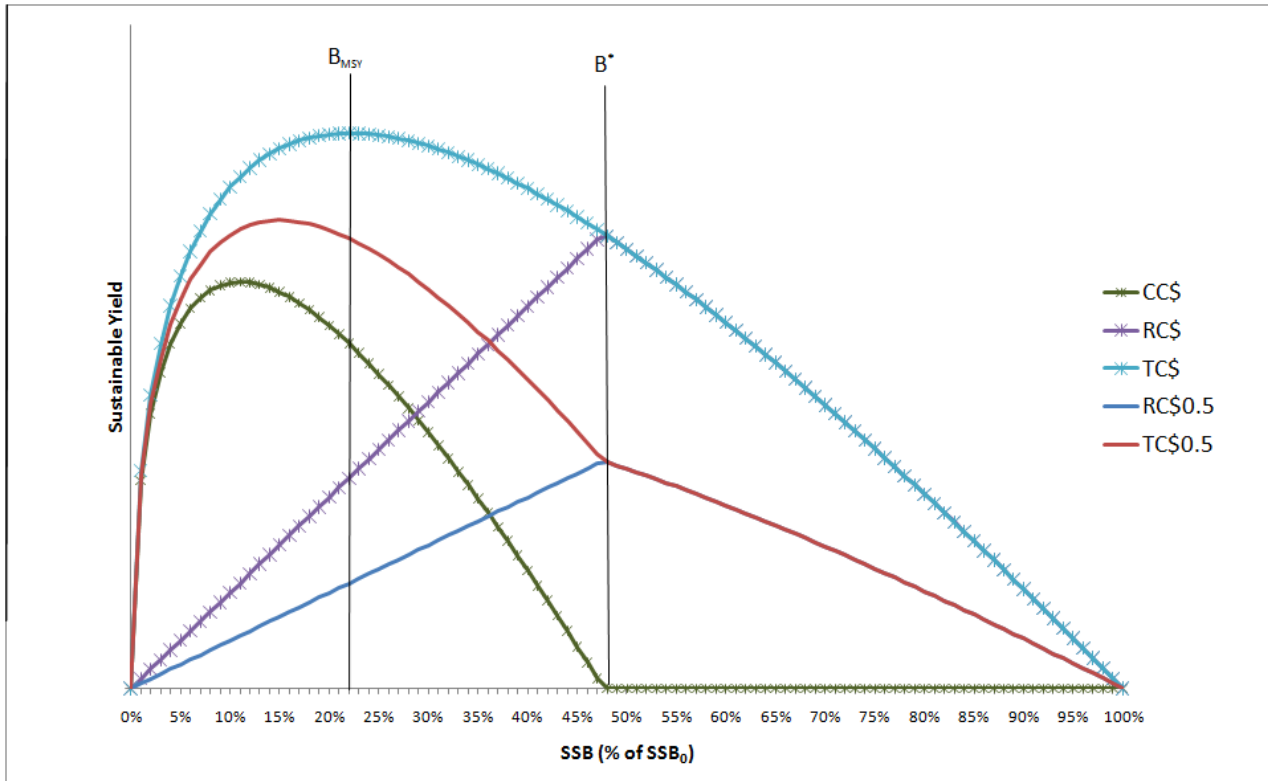
- Is relationship between recreational catch and SSB linear, and what variables influence this relationship?
- If reduce TACC, and SSB grows, does:
 - Recreational catch rate increase pro rata due to greater abundance?
 - Catch n keep vs catch n release behaviour change?
 - Size distribution of fish in landed catch change?
 - Recreational effort increase or decrease in response to higher catch rate, and/or to more big fish in landed catch, and if so, how?
- Because TACC is only effective policy instrument:
 - Many combinations of commercial catch and recreational catch depicted in Figure 1 will not be achievable
 - What level of TACC and associated SSB will maximise sustainable total economic value from a shared fishery?

Total catch value: RC unit value = CC unit value



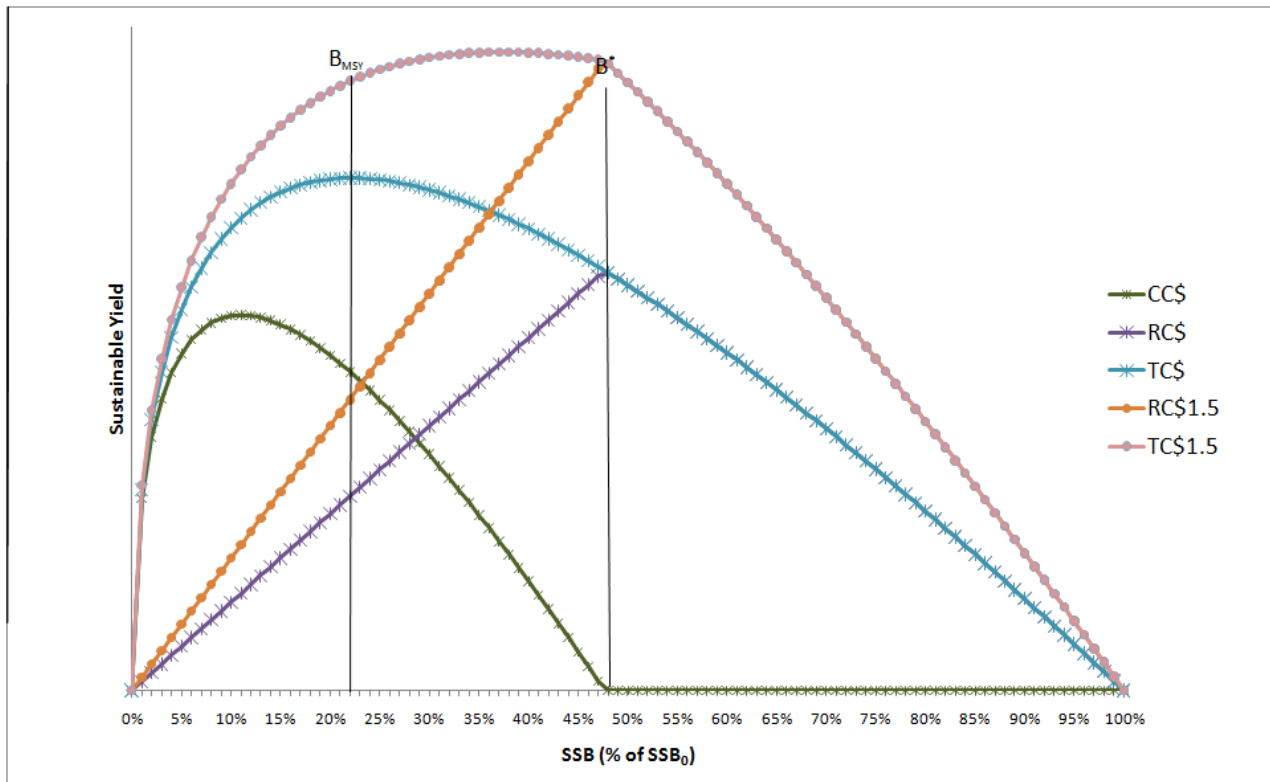
- Assume unit value of RC and CC are equal and both invariant wrt size of catch
- Maximum value of total catch at $SSB = B_{MSY}$
- = lower bound corner solution

Total catch value: RC unit value = 0.5(CC unit value)



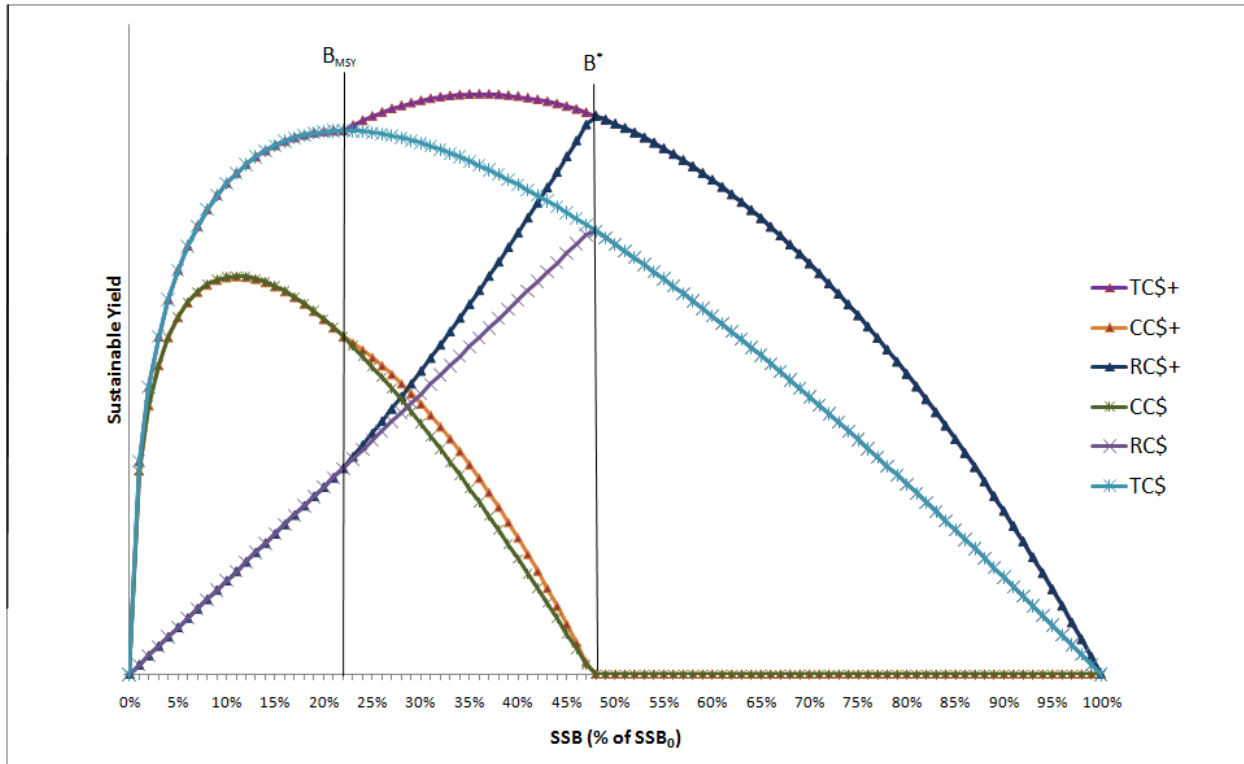
- Assume unit value of RC is 50% of CC unit value and both invariant to size of catch
- Maximum value of total catch at $SSB < B_{MSY}$
- Sustainable optimum @ lower bound corner solution = B_{MSY}

Total catch value: RC unit value = 1.5(CC unit value)



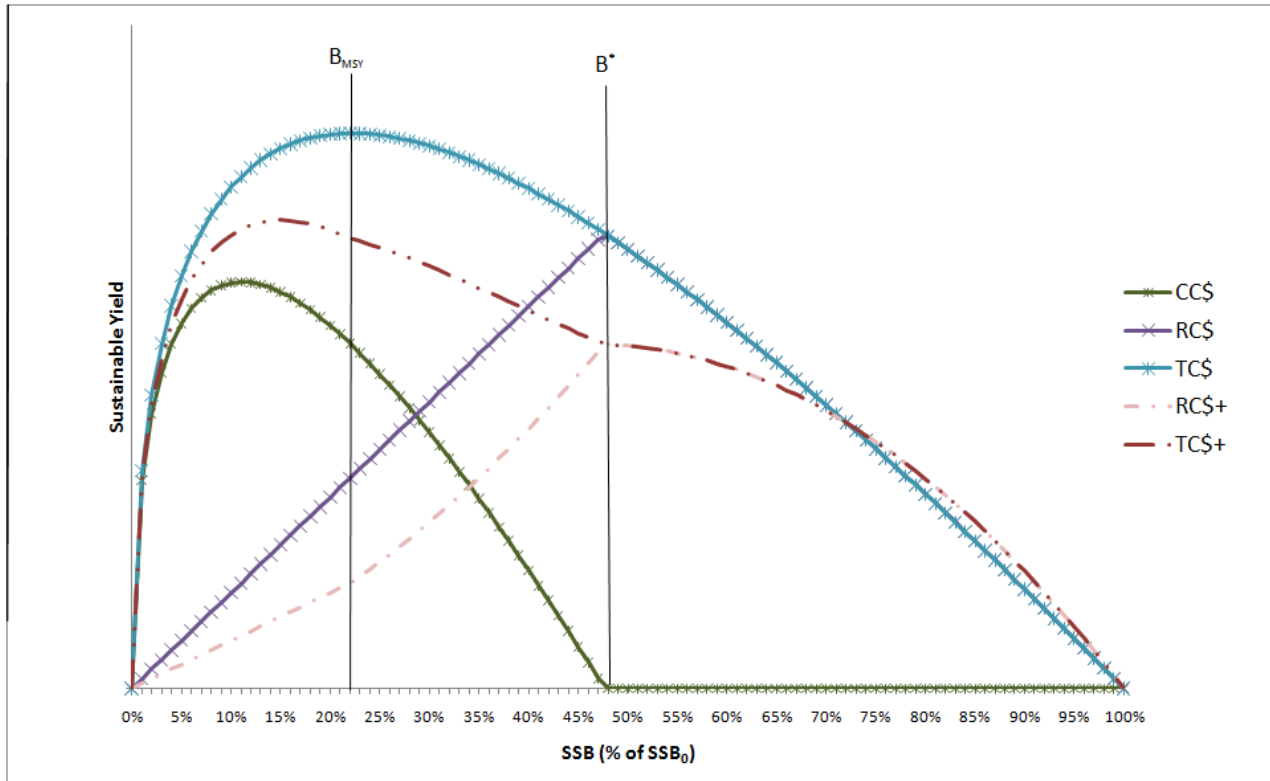
- Assume unit value of RC is 150% of CC unit value and both invariant to catch size
- Maximum value of total catch @ $B_{MSY} < SSB < B^*$
- Interior solution for sustainable optimum
- Sustainable optimum @ upper bound if RC unit value $> 1.75 * CC$ unit value

Total catch value: RC unit values increasing (i)



- Assume unit values of CC & RC equal & both increasing for $SSB > B_{MSY}$
- Maximum value of total catch @ $B^* > SSB > B_{MSY}$
- Interior solution for sustainable optimum
- If faster increase in unit values, upper bound corner solution @ $SSB = B^*$

Total catch value: RC unit value increasing (ii)



- Maximum value of total catch @ $SSB < B_{MSY}$
- Sustainable optimum @ B_{MSY}
- Lower bound corner solution

Key questions on recreational fishing

- **If reduce TACC, and SSB grows, ceteris paribus how does:**
 - Recreational catch rate respond to greater abundance?
 - Do recreational fishers value higher catch rate per se?
 - Recreational effort respond to higher catch rate?
 - Size distribution of fish in landed catch change?
 - Is value to of one 2kg fish > two 1kg fish?
 - Recreational effort respond to more big fish in landed catch ?
 - Catch n keep vs catch n release behaviour change?
- **How to measure unit value of recreational catch due to reduced TACC**
= change in aggregate value of recreational catch/
change in size of recreational catch

CONCLUSIONS

- Catch allocated by setting total allowable commercial catch (TACC), then let stock biomass (SSB) and recreational catch (RC) adjust until fishery sustainable yield (SY) = TACC + RC
- Sustainable range is $0 < TACC < TACC_{MSY}$ i.e. $B_{MSY} < B < B^*$
- Marginal value to recreational fishers of reallocating one tonne from the commercial catch equals increase in aggregate annual value of recreational catch from consequential increase in stock biomass due to:
 - Extra recreational catch from higher catch rate
 - Extra recreational catch from greater effort motivated by more value
 - recreational catch valued more highly because bigger fish caught,
 - recreational catch valued more highly because higher catch rate
- Corner solution catch allocations where TACC equals either zero or $TACC_{MSY}$ are quite likely to be optimal under many circumstances.