

# How Discard Estimates are Used in Stock Assessment and Quota Setting

CT Sea Grant Bycatch Workshop

UC Avery Point Feb 1, 2003

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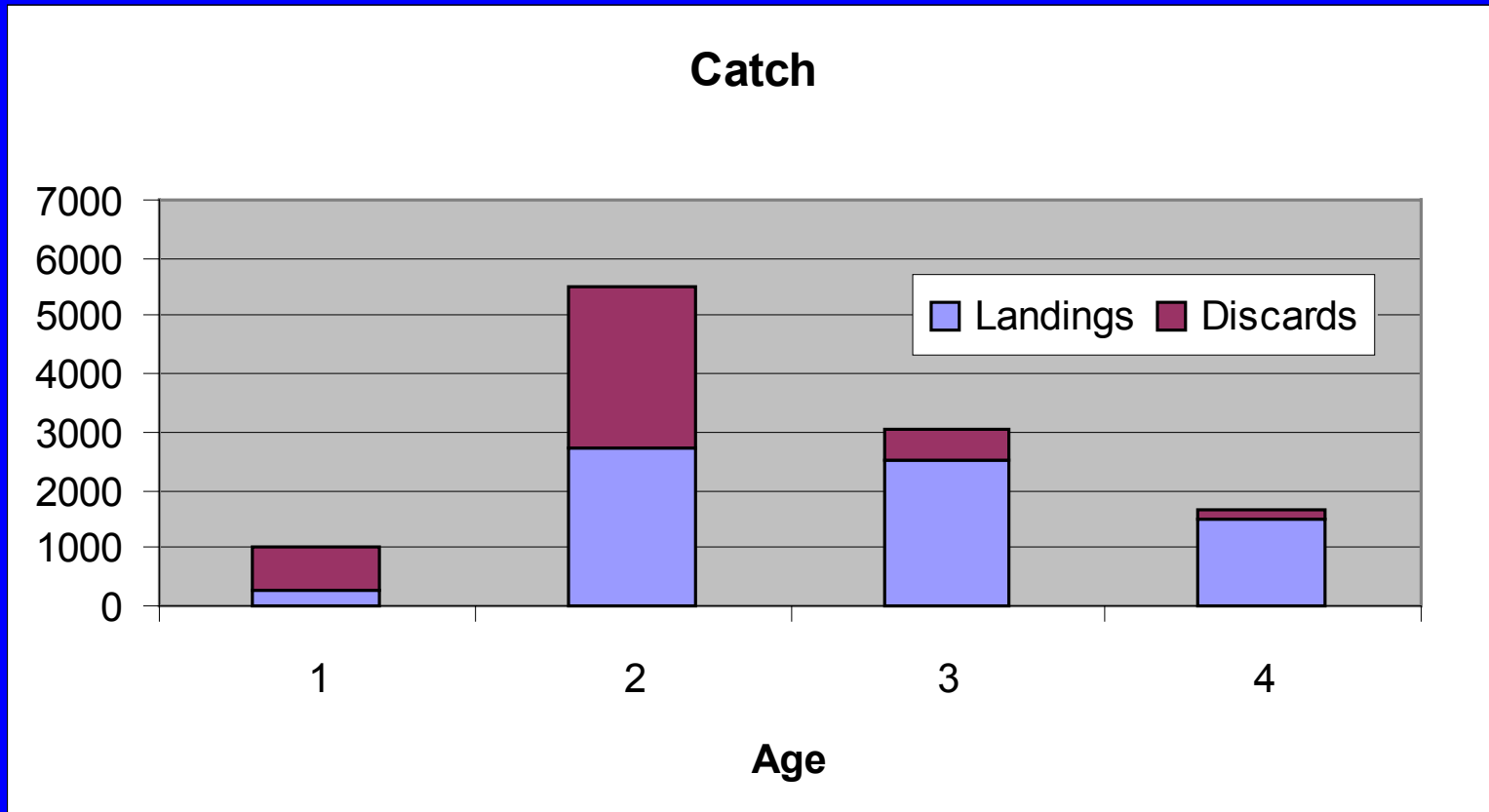
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# DISCARDS

Fish thrown overboard dead, eaten by  
birds, other fish etc.

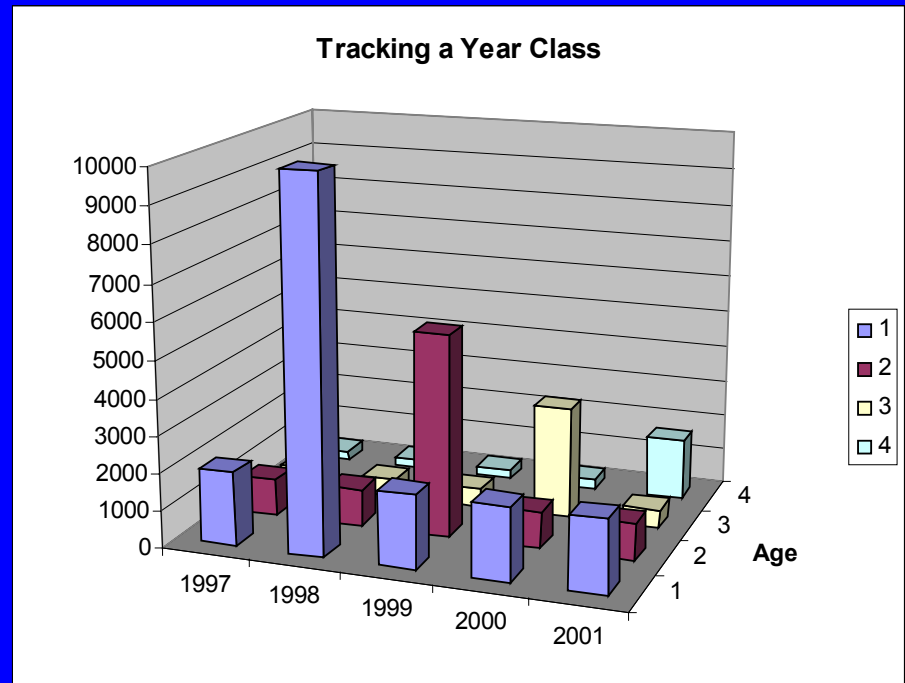
# CATCH = LANDINGS + DISCARDS



To Estimate Stock Size and Set  
Quotas You Must “Know” the  
Volume of Catch

# Virtual Population Analysis

- A method of working backwards through a year class of fish to estimate historical stock numbers and fishing mortality by year and age



# Information Needed in VPA

(all by year and age)

- Catch = Numbers Landed & Discarded
- Catch Weight: Mean Weight
- Natural Mortality
- Percent Mature
- Abundance (Tuning) Indices

# Basic VPA Results

(by year and age)

- ESTIMATES OF:
- *1) Stock Size (Numbers and Weight)*
- *2) Fishing Mortality*

# Stock Size

(by year and age)

- Stock Size = Catch  $\cdot (Z \div (F \cdot U))$ 
  - Z=Total Mortality Rate
  - F=Fishing Mortality Rate
  - U=Percent of Fish Dying that year

# Stock Size

(example: for Age 2 in 1999)

- If Catch=10,000 fish and
- $Z=0.6$ ,  $F=0.4$ ,  $U=0.45$
- Then the Stock Must be:
- $(0.6 \div (0.4 \cdot 0.45)) = 3.3$  times larger than the Catch
- So:
- $10,000 \cdot 3.3 = 33,000$  fish in 1999 stock at age 2

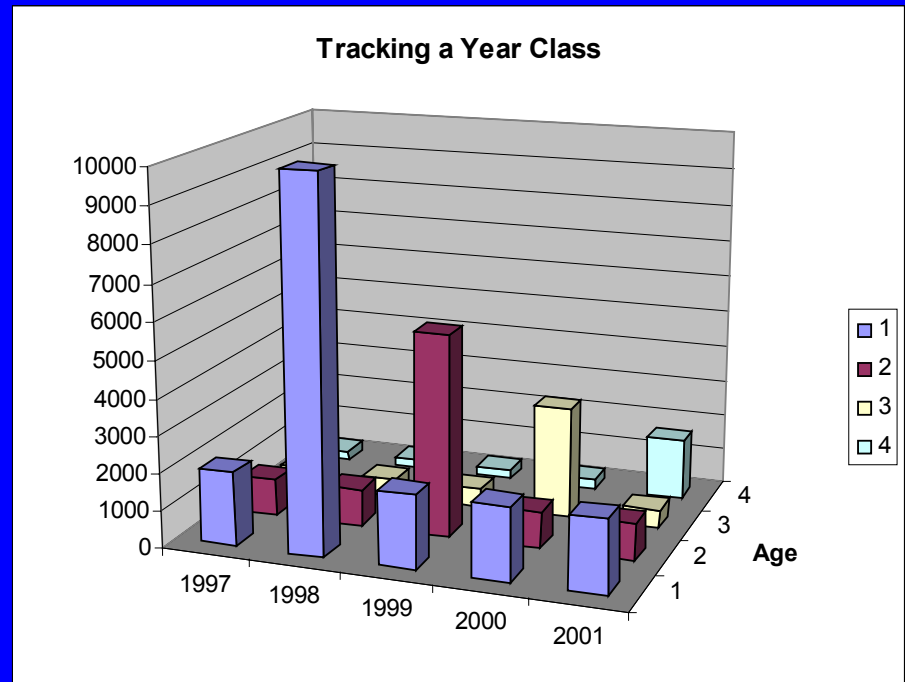
# Fishing Mortality (F)

(example: for Age 2 in 1999)

- $F = (Z - M)$  *or*
- $F = (0.6 - 0.2) = 0.4$ 
  - Total Mortality= $Z = \ln[N \div (N \cdot e^{(-M)} - C \cdot e^{(-M/2)})]$
  - Natural Mortality =  $M = 0.2$
  - Catch (C) = 10,000 fish,
  - Population Est. (N) = 33,000
  - Natural Mortality (M) = 0.2

# Virtual Population Analysis

- **Stock Size** and **Fishing Mortality** estimated for every year, age
- Estimates improve as we go back in time
- “Tuning Indices” aid most in estimating recent **Stock Size**, **Fishing Mortality**



Catch is Key  
to  
Estimating Stock Size

*What if it's wrong???*

# Scenario 1

- If Catch in all cells is increased 50%
- Result:
  - F: is unchanged in all ages and years
  - Stock Size increases 50% in all ages and years.

	1997	1998	1999	2000	2001
1	2000	10000	2000	2000	2000
2	1000	1000	5500	1000	1000
3	500	500	500	3025	500
4	250	250	250	250	1664
	1997	1998	1999	2000	2001
1	3000	15000	3000	3000	3000
2	1500	1500	8250	1500	1500
3	750	750	750	4538	750
4	375	375	375	375	2496

# Scenario 2

- If Age 1 Catch (red cells) is increased 50%
- Result
  - F: at age 1 (red) higher, all other cells unchanged
  - Stock Size in red and gold slightly higher

	1997	1998	1999	2000	2001
1	2000	10000	2000	2000	2000
2	1000	1000	5500	1000	1000
3	500	500	500	3025	500
4	250	250	250	250	1664
	1997	1998	1999	2000	2001
1	3000	15000	3000	3000	3000
2	1000	1000	5500	1000	1000
3	500	500	500	3025	500
4	250	250	250	250	1664

# Scenario 3

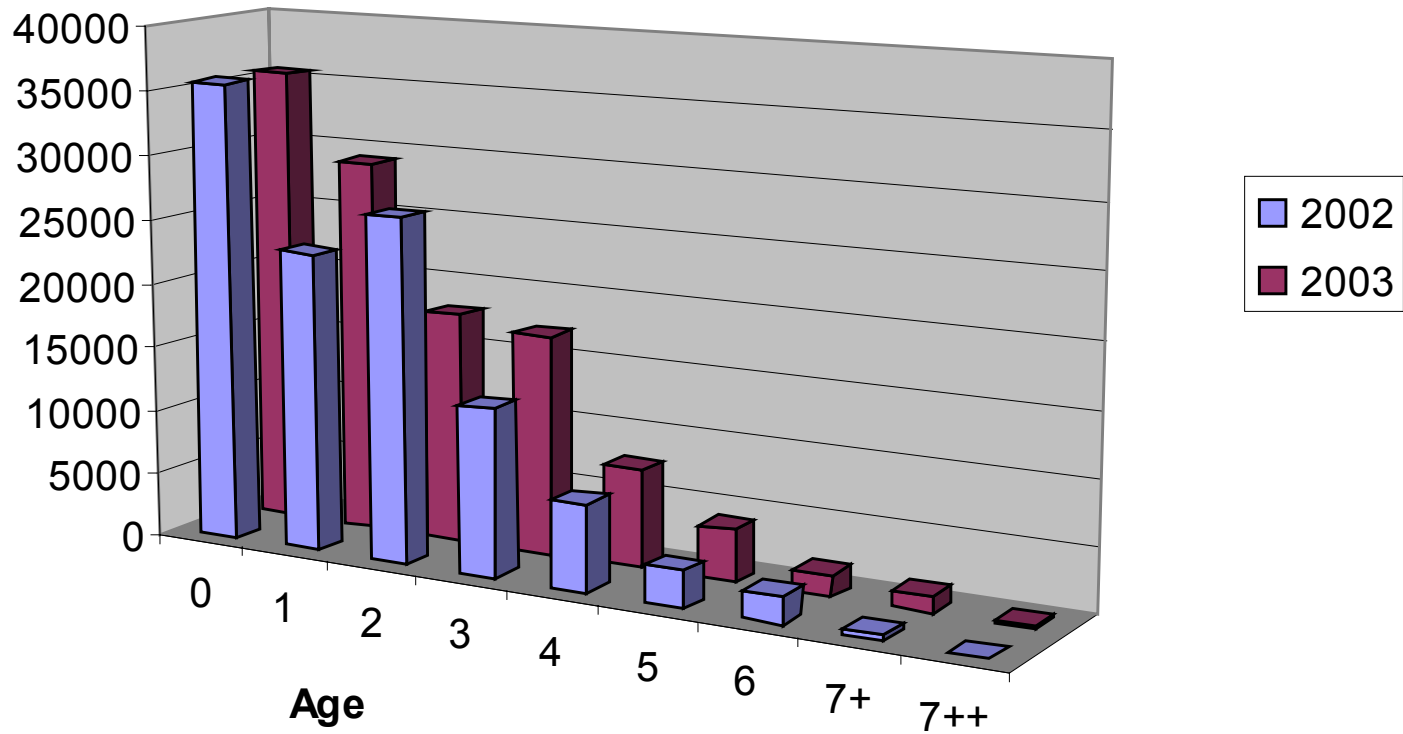
- If catch in last two years (red cells) is increased 50%
- Result
  - F: years in red F increase, in gold cells F declines, 1999 mixed
  - Stock Size increase in 1996 and subsequent year classes

	1997	1998	1999	2000	2001
1	2000	10000	2000	2000	2000
2	1000	1000	5500	1000	1000
3	500	500	500	3025	500
4	250	250	250	250	1664
	1997	1998	1999	2000	2001
1	2000	10000	2000	3000	3000
2	1000	1000	5500	1500	1500
3	500	500	500	4538	750
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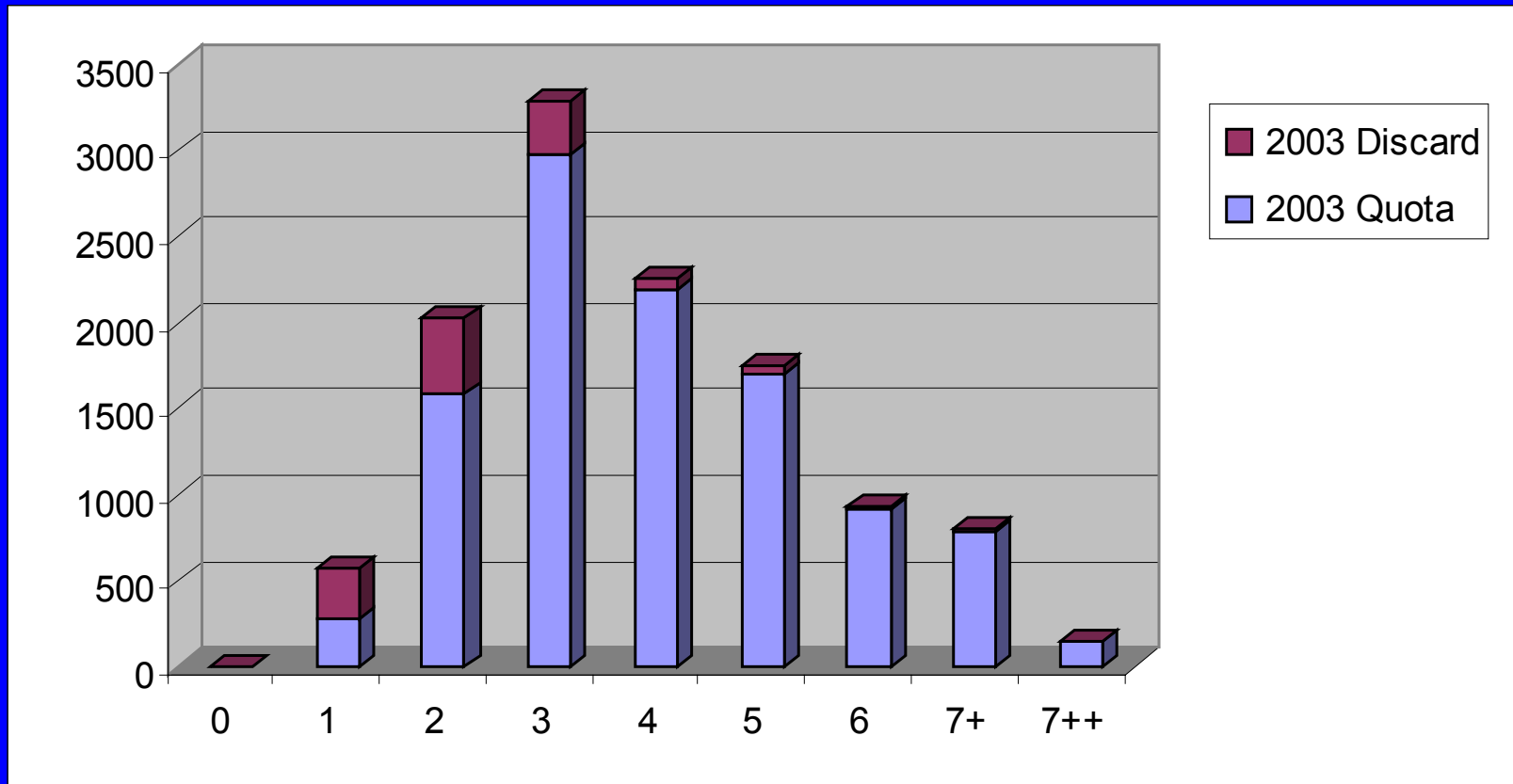
How are Discards Used in  
Setting the Quota?

Projecting Stock Size for the  
Coming Year

# Projecting Stock Size



# TAC - Discards = Quota (2003 TAC by Age)



# Summary

- CATCH IS KEY
  - Unaccounted for Catch will generally result in lower estimates of Stock Size / Quotas

# Conclusions

## How to Improve Catch Data

- More Complete Reporting of Landings
- Increased Sea-Sampling (lengths, volume)
- More FVTR Discard Data Reporting
- More information on Size of Discards in the Recreational Fishery



# Why Use Instantaneous Rates? (F,M,Z)

Both Lines Depict a 50% Decline

