Virtual Population Analysis (VPA)

fish5104vpa Assessment methods based on back-calculations

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December 19, 2016

Traditional VPA

Assumptions of VPA:

- F is assumed to be known in the last year
- M is assumed to be known
- Catch is assumed to be without error

VPA is based on the following equations:

Stock equation

$$N_{a+1,y+1} = e^{-Z_{ay}} N_{ay}$$

Catch equation

$$C_{ay} = \frac{F_{ay}}{Z_{ay}}(1 - e^{-Z_{ay}})N_{ay}$$

Traditional VPA - The last year

F is given in the last year

M is given

Catch is given

Solve the catch equation with respect to N

$$N_{ay} = \frac{C_{ay}}{\frac{F_{ay}}{Z_{ay}}(1 - e^{-Z_{ay}})}$$

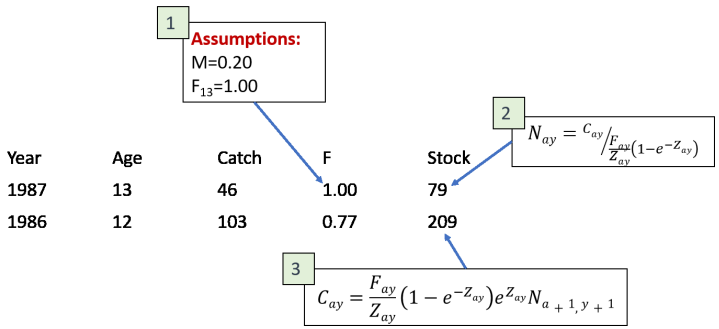
Traditional VPA - Penultimate year

Have N for last year $(y+1)$

$$C_{ay} = \frac{F_{ay}}{Z_{ay}}(1 - e^{-Z_{ay}})e^{Z_{ay}} N_{a+1,y+1}$$

The catch equation is not easy to solve with regards to F.

Use numerical methods



F on the oldest age

F of the oldest ages is an average of younger years

Backcalculating a cohort

Can now back-calculate the entire cohort, year by year

Year	Age	Catch	F	Stock
1987	13	46	1.00	79
1986	12	103	0.77	209
1985	11	217	0.66	492
1984	10	512	0.66	1159
1983	9	2054	0.95	3648
1982	8	7666	1.05	12770
1981	7	12710	0.64	29474
1980	6	15119	0.38	52576
1979	5	13772	0.21	79358
1978	4	16286	0.17	114847
1977	3	2614	0.02	143157

Assumptions :
M=0.20
F13=1.00

VPAs using different input Fs should be compared

Year	Age	Catch	F	Stock
1987	13	46	0.80	91
1986	12	103	0.70	223
1985	11	217	0.63	510
1984	10	512	0.64	1182
1983	9	2054	0.93	3675
1982	8	7666	1.05	12804
1981	7	12710	0.64	29516
1980	6	15119	0.38	52628
1979	5	13772	0.21	79422
1978	4	16286	0.17	114924
1977	3	2614	0.02	143252

Assumptions:
M=0.20
F13=0.80

Convergence properties of VPA

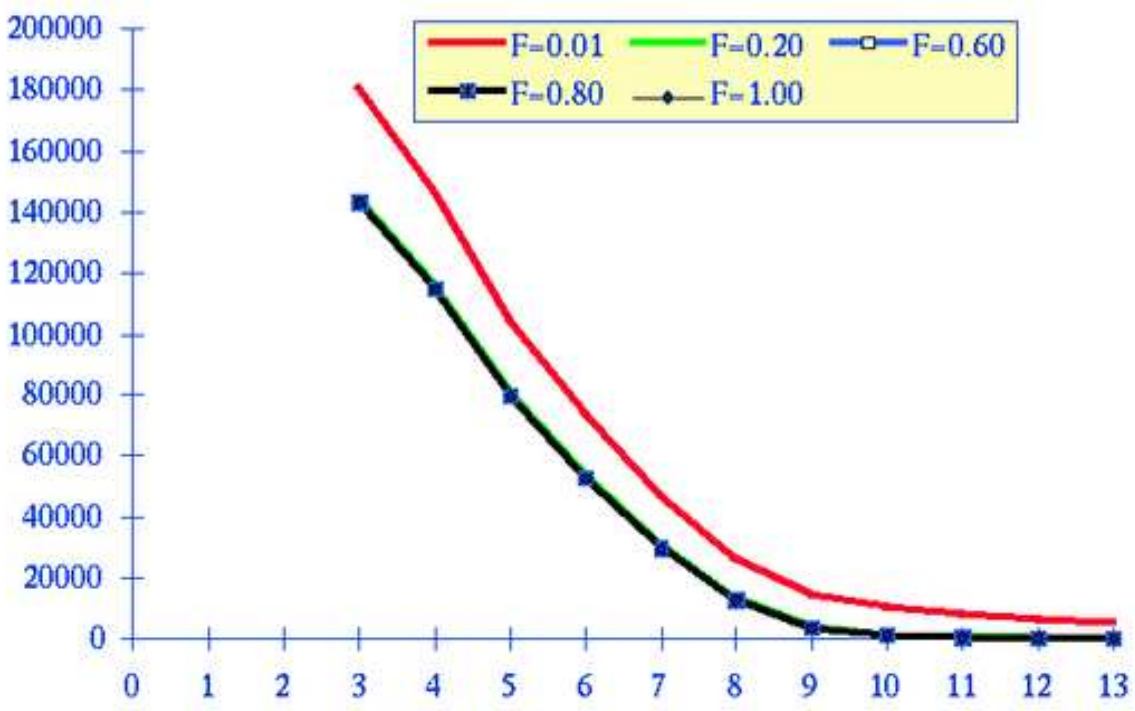
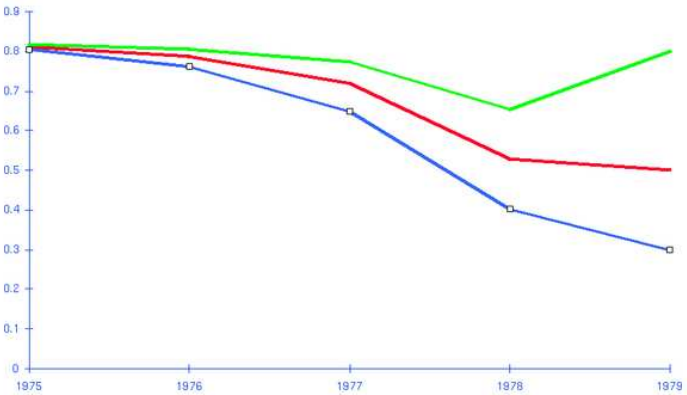


Figure : The above figure describes the size of a year-class for a variety of assumptions of fishing mortality.

Revising assumptions for the last year

F in the last year= Average of earlier



Used historically - or to reevaluate the terminal year

The selection pattern

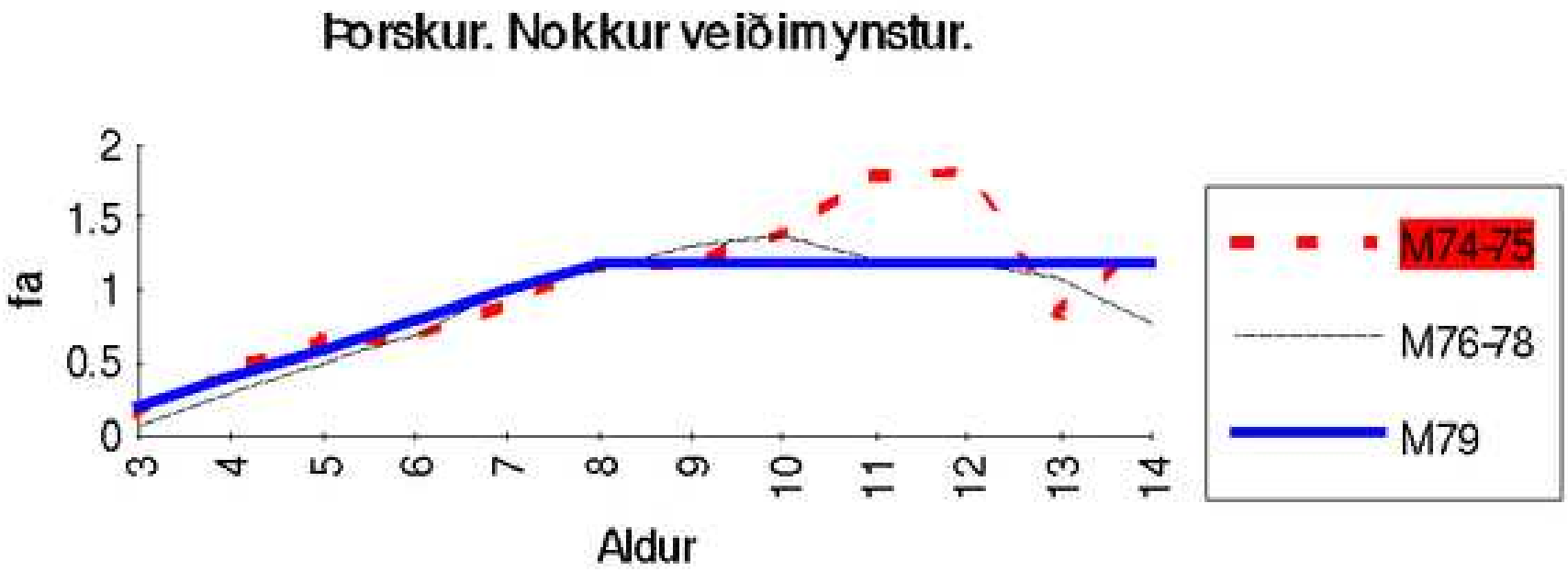


Figure : Fishing pattern by age= Scaled F

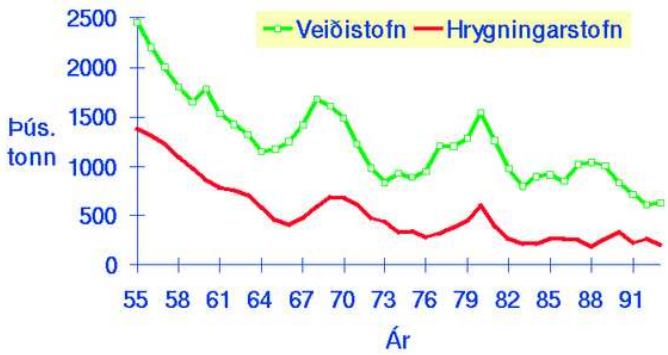
Revising the last year

To re-estimate the last year:

- assume constant F
- use effort data
- use the survey index
- use more elaborate "tuning"
- move to statistical methods

I-cod, Historical stock development

- Assume M
- Assume F in last year
- Back-calculate
- Check consistency: Fishing pattern trend
- Revise F in last year
- Repeat VPA



VPA gives historical trends in stock size as well as historical recruitment.