Háskóli Íslands	**09.51.70 Fiskifræði**	**Raunvísindadeild**
Laugardagur	**13. maí 2006**	**kl 09:00-12:00**
Permissible accessories: Notes, books and all types of calculators	**Note** that equipment such as laptops and mobile phones are not permittted	**The weight** of each problem is given.

1. (10) Fig. 1 shows yield per recruit vs fishing mortality for a range of natural mortalities (M=0.1, 0.2, 0.3, 0.4) where Z has been estimated at 0.95. Keep this figure in mind when you give justified answers to the following:

(a) In the case of a well-managed situation (low F), if M suddenly increased (from 0.1 to 0.2), should one the increase or decrease F to obtain as much yield (per recruit) as possible? ?
(b) If M was earlier underestimated and a revised estimate indicates it to be higher, does this increase or decrease the F in the assessment?
(c) What is F and what will the yield per recruit be if natural mortality is $M = 0.1$?

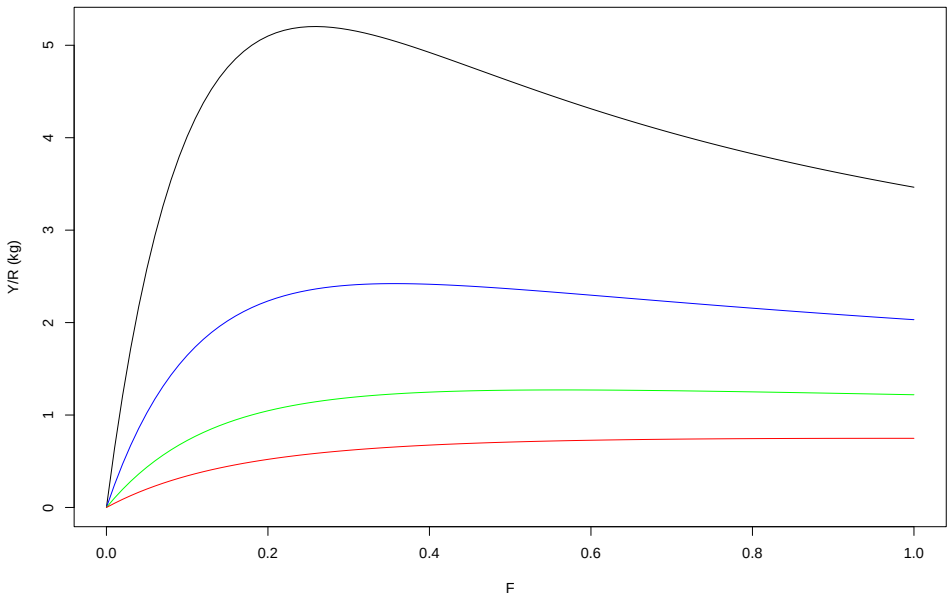

Figure 1: Yield per recruit for various values of M
Mynd 1: Afrakstur á nýliða miðað við mismunandi M

2. (15) The following table gives mean weight (g) by age, the selection pattern, natural mortality, proportion mature and an estimate of the abundance of the different age groups (number of fish) in a small stock at the beginning of the year 2006. It is believed that the average fishing mortality on 5-6 year old fish was about 0.7. A recruitment forecast indicates that recruitment in 2007 will be 120 thousand individuals.

(a) Predict the stocksize in numbers by age at the beginning of the year 2007.

(b) Predict the catch in tonnes during the year 2007 assuming no change in effort.

Take care of the units.

Age	w_a	s_a	M_a	p_a	N_a
1	0.008	0.05	0.2	0.00	90 000
2	0.050	0.25	0.2	0.00	30 000
3	0.150	0.50	0.2	0.01	30 000
4	0.300	0.75	0.2	0.05	20 000
5	0.500	1.00	0.2	0.30	2 000
6	0.750	1.00	0.2	0.75	5 000

3. (20) Use the number in problem (2) as needed to compute the yield per recruit and spawning stock biomass per recruit for $F = 0.4$.

4. (25) Fig. 2 shows (a) yield per recruit, (b) spawning stock biomass per recruit, (c) a Beverton-Holt stock-recruitment relationship ($R = \alpha S/(1 + S/K)$) along with replacement curves corresponding to F=0, 0.25, 0.35 and F_{crash} and finally (d) equilibrium catch vs spawning stock biomass. Some of the figures include lines for reference (corresponding to the same F-values).

(a) Find F_{crash}?
(b) Compute the size of the equilibrium SSB at $F = 0.25$.
(c) What will the (average) recruitment be at $F = 0.25$?
(d) If the stock starts at 250Kt, where will it go if 20Kt are caught each year?
(e) If the stock starts at 50Kt, where will it go if 20Kt are caught each year?
(f) What will the (average) recruitment (eventually) become under a moratorium?

Data (in some cases the figures alone can be used):

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    F Y/R  S/R
 0.00 0.0 27.8
 0.25 2.3 10.7
 0.35 2.4  8.0
 1.10 2.0  2.0
 1.20 1.9  1.8
 1.30 1.9  1.6
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Known constants: $\alpha = 0.5621$, $K = 20000$(t).

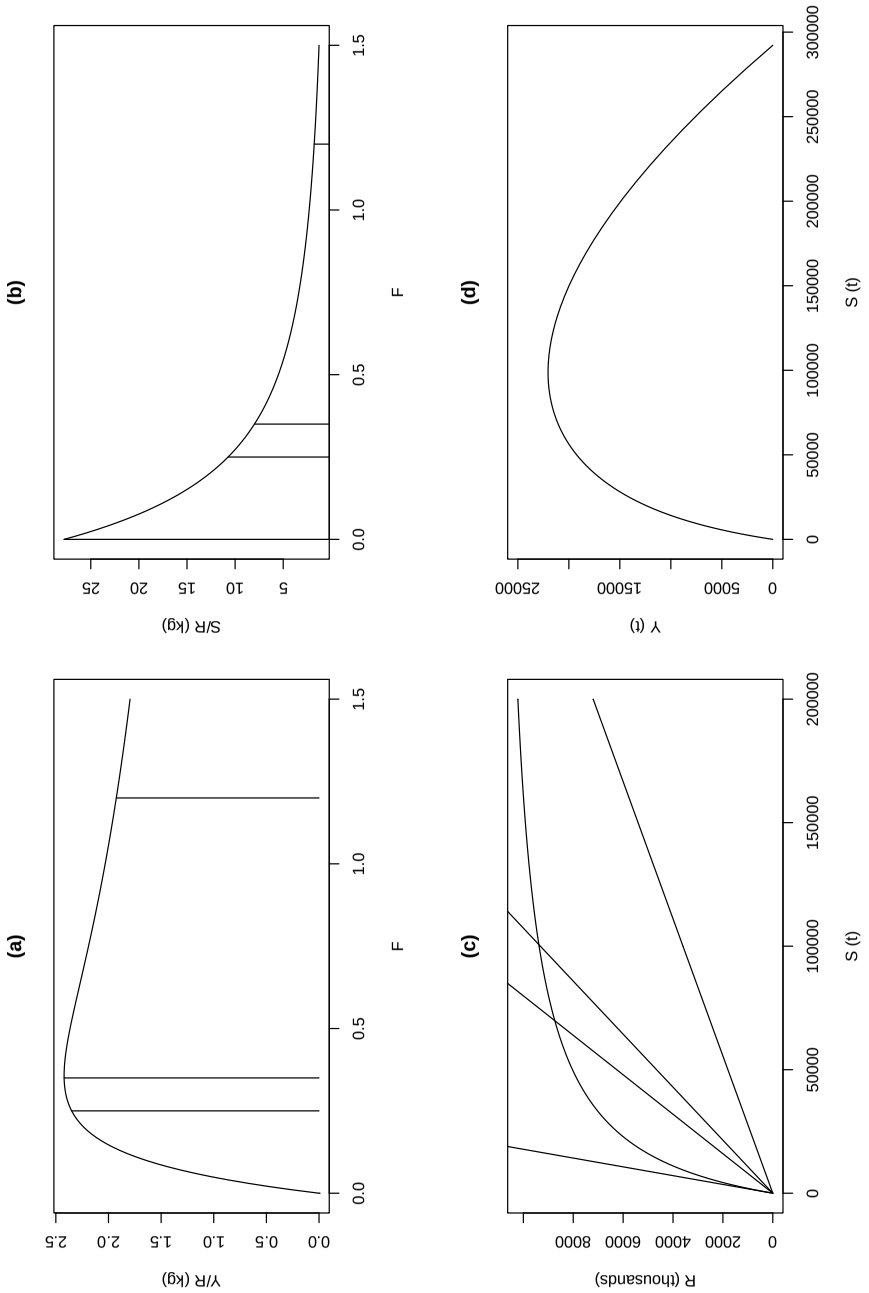

Figure 2: Various figures, see text.
Mynd 2: Ýmsar myndir, sjá texta.

5. (10) Several tags were placed in the 1999 yearclass of the sillystock when it came under moratorium at the beginning of year 2000. During the first following year a survey caught large numbers of tagged fish. In the fourth survey year, however, the number of tagged fish caught was only 5% of the number caught in the first year. Estimate natural mortality.

6. (20) The coefficients α and K describe the shape of the Ricker curve.

(a) It has been claimed that the maximum of the Ricker stock-recruitment curve corresponds to the maximum yield. Is this (always) correct? (justify the answer).

(b) If the yield per recruit is a strictly increasing function of fishing mortality and the stock-recruitment relationship is of the Ricker type, which is larger, K or B_{MSY}?

[Hint: Draw the Ricker curve along with a replacement curve which passes through the peak. Put the same F into a Y/R graph. Now note, how R and Y/R change when fishing more or less that corresponding to this fishing mortality. Draw whatever conclusions can be drawn on how the yield Y changes as F decreases or increases and thus find whether F_{MSY} is larger or smaller than this F and then answer the original question.]

(c) If SSB is measured in tonnes and the number of individuals is in millions, what is the unit of the coefficient α in the Ricker curve?