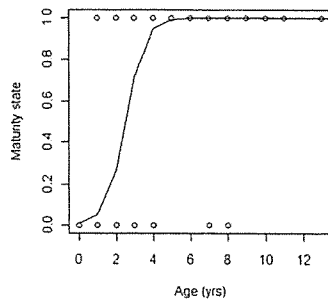


答案請填寫於試卷內，附上題號，並依序作答。可用中文或英文作答。

一、選擇題（每格 3 分，共 30 分；答案請填寫於試卷內，勿於試題上作答）

a) Because of the [A] characteristics and the [B] propensity with ages or lengths for maturation, it is common to apply a [C] to describe the probability of maturity over an organism's lifetime. The figure below shows a regression fit of maturation data for a hypothetical fish population. Commonly, to quantify the maturation schedules for a population we derive the [D] index, which is the age at which [E] become mature.



b) [F] denote the phenomena that relatively large or old fish tend to have relatively high fecundity, produce large eggs that give rise to high [G], and spawn for long periods, spreading the risk of egg die-offs from [H]. Consequently, to avoid [I] failure, it is beneficial to maintain old population [J] structures for fisheries populations.

Choose the appropriate answers for [A]-[J] from the following candidates.

(1) cannibalism, (2) recruitment, (3) 50<sup>th</sup> of the population, (4) decreasing, (5) age-specific mid-point of maturity ogive, (6) random, (7) unstable, (8) demographic, (9) binary, (10) increasing, (11) logistic regression, (12) nonlinear, (13) environmental stochasticity, (14) climate variability, (15)  $A_{50}$ , (16) starvation, (17) life history, (18) regulation, (19) genetic, (20) biodiversity, (21)  $\chi^2$  test, (22) 50% of the population, (23) reproductive, (24)  $L_{50}$ , (25) linear regression, (26) larval survival rates, (27) maternal effects, (28) 50% standard deviation of the population, (29) larval mobility, (30) egg fat profiles

二、簡答題(每題 6 分，共 30 分)

a) **Catch-per-unit-effort (CPUE):** CPUE data are fundamental to the assessment of status of fisheries resources. Describe what CPUE is and how it can be used in fisheries assessment.

b) **Mortality:** In fisheries assessment, mortality of fish is quantified into natural and fishing mortalities. Provide definitions of natural and fishing mortalities.

c) **Age and growth:** Describe a method to examine ages and growth rates of fish, and explain why it is important to understand these metrics in fisheries management.

d) **Anthropogenic effects:** Describe 2 examples of how human activities can cause negative impacts on fisheries populations.

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e) **Fishing selectivity:** Most fishing gears are selective; e.g., targeting fish of certain lengths. Give 2 examples of size selectivity for 2 common fishing gears; e.g., gillnets 刺網, trawlers 拖網, longlines 延繩釣, set nets 定置網, hook and lines 釣竿, etc.

三、問答及計算題

a) (10 分) Based on the concept of “r-K selection”, what are the environmental and life history characteristics for the r- vs. K-selected fish species? Give 1 representative species for the r- and K-types.

b) (6 分) Maturation schedules for many exploited fishes are observed to decrease; e.g., the age at maturity for the Atlantic cod *Gadus morhua* in the Arctic Ocean changed from 8 to 6 years old. Give two potential mechanisms to explain the changes of maturation schedules.

(4 分) Suppose that declining trends of maturation schedules are observed for some exploited fishes in Taiwan. Should we be worried about this? Why or why not?

c) (5 分) Pauly (1980) suggested the following equation to describe natural mortality ( $M$ ;  $\text{yr}^{-1}$ ) for fishes:

$$\log M = -0.0066 - 0.279 \log L_{\infty} + 0.6543 \log K + 0.4634 \log T$$

$L_{\infty}$ : theoretical asymptotic lengths,  $K$ : Brody growth coefficient,  $T$ : habitat temperature ( $^{\circ}\text{C}$ ).

Based on this equation, describe the differences in natural mortality between species in relatively warm vs. cold environments.

(5 分) Fill in the blanks: Based on the equation above, the natural mortality for fast-growing species would be relatively (1), whereas that for the large-sized species would be (2). Assuming that habitat temperature is constant.

d) (10 分) The gonadosomatic index (GSI) is the ratio of gonad mass to body mass. The figure to the right shows the GSI data for female and male fish. Describe the differences in GSI between sexes. To compare the GSI between sexes, does it make sense to lump all monthly data together or to compare sexual differences month-by-month? Provide reasons for your analytic approach.

