Country: _____	Student Code: _____

23rd INTERNATIONAL BIOLOGY OLYMPIAD

8th – 15th July, 2012

SINGAPORE

PRACTICAL TEST 4

ANIMAL ANATOMY & ECOLOGY

Total points: **100**

Duration: **90 minutes**

Dear Participants 親愛的參試者

- In this test, you have been given the following two tasks:

  在此項考試，你須操作下列兩部分：

  Task I: Anatomy of molluscs. (20 points)

  第一部分：軟體動物的解剖 (20 分)

  Task II: Rank-abundance plots, ABC curves and community structure. (80 points)

  第二部分：位序-豐度對應圖，ABC曲線及群落結構(80 分)

- Use the **Answer Sheet**, which is provided separately, to answer all the questions.

  使用所提供的**答案卷**，回答所有問題

- The answers written in the Question Paper will **NOT** be evaluated.

  如將答案填在試題卷上，將**不計分**

- Write your answers legibly in ink.

  將你的答案以 原子筆清晰作答

- Please make sure that you have received all the materials and equipment listed for each task.

  If any of these items are missing, please raise your hand **immediately**.

  確實檢查每一部分進行操作時所需要的實驗器材；如有任何器材缺失，請**立刻**舉手。

- Stop answering and put down your pen IMMEDIATELY when the bell rings.

  當鈴聲響時，停止作答並**立刻**將筆放下

- At the end of the test, place the Answer Sheet and Question paper in the envelope provided.

  Our Assistants will collect the envelope from you.

  在考試結束時，將答案卷及試題卷放入所提供之封袋中。助理將自你處收集試卷封袋。

Have fun and Good Luck! ☺ 好好享受 祝你好運

Materials and equipment: 實驗材料與儀器

For Task I: Anatomy of molluscs

第一部分：軟體動物解剖

Materials and equipment 實驗材料與儀器	**Quantity 數量**	**Unit 單位**
Mollusc 1 (in vial) 軟體動物 1 (在小瓶內)	1	specimen 標本
Mollusc 2 (in vial) 軟體動物 2 (在小瓶內)	1	specimen 標本
stereomicroscope 解剖顯微鏡	1	set 座
scissors 剪刀	1	pair 支
forceps 鑷子	3	pairs 支
plastic tray 塑膠盤	2	piece 個
water (in beaker) 水(於燒杯內)	1000	mL
paper towels 紙巾	4	sheet 張

For Task II: Rank-abundance plots, ABC curves and community structure

第二部分：位序-豐度對應圖，ABC 曲線與群落結構

Materials 實驗材料	**Quantity 數量**	**Unit 單位**
Community 1 群落 1	1	bag 袋
Community 2 群落 2	1	bag 袋
Table A 表 A	1	sheet 張
Table B 表 B	1	sheet 張

Task I (20 points)

Anatomy of molluscs 軟體動物解剖

Introduction 前言

Members of the class Bivalvia are successful molluscs with a long evolutionary history. They possess hinged left and right shell valves that enclose a headless animal within.

在長期演化史中，雙枚貝(Bivalvia)算是成功的軟體動物，藉左右兩瓣相連的貝殼包住無頭的動物體。

Vials labelled 1 and 2 contain two species of marine bivalves that are common in tropical Asia but live in different habitats. The specimens were partly boiled and preserved in 70% ethanol.

1 號及 2 號小瓶中裝有兩種海生雙枚貝，雖均為熱帶的亞洲海洋中常見種，但生活於不同棲地。二標本均已被煮過，並保存在 70%酒精中。

Follow the instructions below to open the animals up for detailed examination under the stereomicroscope.

根據以下指示剖開標本，並在解剖顯微鏡下觀察。

- Locate the anterior (if present) and posterior adductor muscles that join the left and right valves of the animal.

  找出前(如果有)及後閉殼肌，即連接左右兩瓣殼的收縮肌。

- Use the pair of scissors to cut the adductor muscles so that the valves can be separated to expose the internal parts of the animal.

  用剪刀剪斷閉殼肌打開貝殼以呈現內部構造。

- Observe the specimens under water in trays provided.

  將標本放在塑膠盤中，加入適量的水進行觀察。

Answer the following questions **in the Answer Sheet**:

回答下列問題，並將答案寫在**答案卷**上

在**答案卷**上回答下列問題：

Q1.1 **(2 points × 2 = 4 points)** In which habitat (a – d) would you expect to find species 1 and 2 respectively?

a. attached to rocks or other hard surfaces

b. boring into coral

c. buried in sand or mud

d. lying unattached on a sandy substratum

(2 分 × 2 = 4 分) 觀察 1 號及 2 號兩種貝類的構造，推測其分別棲於 (a – d) 何種棲地?

a. 附在岩石或其他堅硬表面

b. 在珊瑚上鑽孔

c. 埋在泥沙中或泥土中

d. 在沙底的下層卻不接觸沙底

Q1.2 **(2 points × 2 = 4 points)** How many pairs of ctenidia (gills) are there in species 1 and 2 respectively? Answer using numerals.

(2 分 × 2 = 4 分) 1 號貝及 2 號貝各有幾對櫛板(鰓)? 請填數字。

Q1.3 **(2 points × 2 = 4 points)** How many pairs of labial palps are there in species 1 and 2 respectively? Answer using numerals.

(2 分× 2 = 4 分) 1 號貝及 2 號貝各有幾對唇鬚? 請填數字。

Q1.4 **(2 points × 2 = 4 points)** Locate the anus near the posterior end of the animal in each species. The anus empties its contents into the path of the exhalant water flow. Starting with the anus, trace the path of the intestine forwards towards the stomach. Indicate the position of the intestine in relation to the heart (a – e) in the two species respectively.

a. intestine passes dorsally over the heart
b. intestine passes under (ventral to) the heart
c. intestine passes through the heart
d. intestine passes to the right of the heart
e. intestine passes to the left of the heart

(2 分× 2 = 4 分) 找出靠近動物體後端的肛門。肛門內容物可藉出水管的水流帶走，由肛門向前方追蹤腸道直到胃，1 號貝及 2 號貝腸道與心臟位置的關係，分別為下列(a – e)何者？

a. 腸道由心臟背面通過
b. 腸道由心臟下方(腹面)通過
c. 腸道穿過心臟
d. 腸道由心臟右面通過
e. 腸道由心臟左面通過

Q1.5 **(0.4 points × 5 = 2 points)** The following is a list (a-e) of anatomical features in molluscs. Indicate with a tick (✓) if the feature may be present in bivalves and with a cross (**×**) if it is always absent.

a. crystalline style

b. eye

c. foot

d. penis

e. radula

(0.4 分 × 5 = 2 分) 下表 (a-e) 顯示軟體動物的解剖特徵，在表中用打勾(✓)表示該特徵可能存在，打叉 (**×**)表示絕不存在。

a. 晶桿

b. 眼

c. 足

d. 陰莖

e. 齒舌

Task II (80 points) 第二部分(80 分)

Rank-abundance plots, ABC curves and community structure

位序-豐度對應圖，ABC 曲線與群落結構

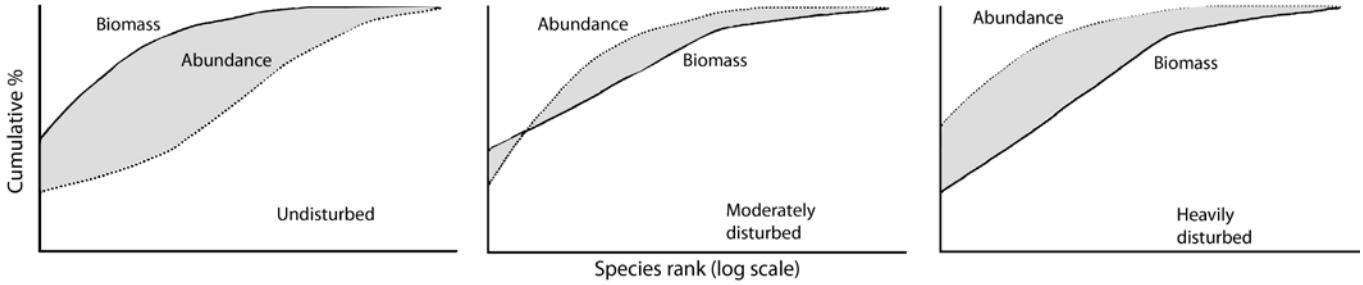
Introduction 前言

Changes in community structure may be visualized using a variety of graphs. A rank-abundance plot or "Whittaker plot" is used by ecologists to display relative species abundance, a component of biodiversity. In this type of graph, the rank of each species is plotted along the X axis. The most abundant species is ranked 1, the second most abundant species is ranked 2, and so forth. The abundance of each species is plotted on the log scale of the Y axis. The shape of the curve can provide an indication of dominance or evenness.

群落結構的改變或可藉由不同的曲線來呈現。位序-豐度對應圖或 "Whittaker 對應圖" 係生態學家用來表示物種的豐度，屬於生物多樣性的一種特質。在此類圖中，各物種根據其排序列於 X 軸上，族群最大種排序為 1，第二多者排序為 2，以此類推。每個物種之豐度以對數尺度呈現分別列於 Y 軸上。此曲線的形狀可顯示優勢度或均勻度。

The Abundance-Biomass Comparison (ABC) method was proposed by Warwick (1986) as a technique for monitoring disturbance on benthic invertebrate communities. ABC curves have a theoretical background in classical theory of *r*- and *K*-selection. The relative positions of the abundance curve and biomass curve serves to indicate the level of disturbance in the community (see graph below).

豐度-生物量比較法(ABC) 係 Warwick (1986)提出的方法，用以監測底棲無脊椎動物群落所遭受的干擾。 ABC 曲線的理論基礎係根據傳統的 r-及 k-選擇。豐度曲線與生物量曲線兩者間的相對位置可用來顯示群落中受干擾的程度(參考下圖)。



說明：Cumulative % 累計 %

Species rank(log scale) **物種排序(對數尺度)**

Abundance 豐度

Biomass 生物量

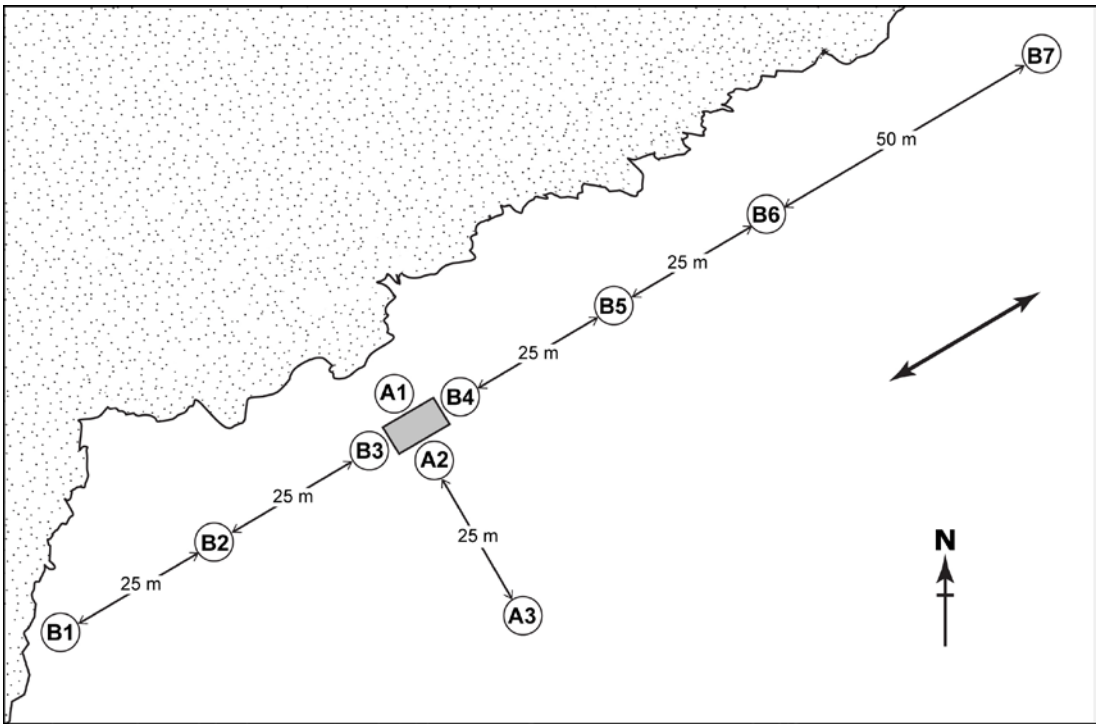
Undisturbed 不受干擾

Moderately disturbed 中度干擾

Heavily disturbed 嚴重干擾

Q2.1 **(16 points × 2 = 32 points)** In an environmental impact assessment (EIA) study on the impact of salmon cage farming on benthic communities, samples were collected from the various stations along two transects, A1 to A3, and B1 to B7 (see figure below).

(16 分 × 2 = 32 分) 在一環境影響評估中(EIA)針對鮭魚圈養場對底棲生物群落的影響進行研究，樣本分別由 2 條穿越線上各樣站取得，包括A1 到A3，及B1 到B7(參考下圖)。



, location of floating salmon cages; ⟷ , indicates direction of current flow along the coast.

鮭魚圈養場的位置　　海岸洋流的流動方向

You are a summer intern at the marine laboratory in which this EIA study is conducted. Your responsibilities include the processing of benthic samples. You are given two bags containing Community 1 and 2 and your job is to process the samples and collate information similar to that carried out by a senior research assistant for Community 3 and 4 (see Table A, page 11 for Summary of the information). Each community may contain any of

the 17 species (A – Q) listed in Table B (page 12); the respective mean fresh biomass per individual of each species is also provided in Table B.

你是參與此環境影響評估(EIA)研究海洋實驗室中的暑期實習生，你所擔任的工作包括處理底棲生物標本，你被分配到 2 袋樣本，分別來自群落 1 及群落 2。你的工作是比照資深研究助理對群落 3 及群落 4 的方式，來處理這些樣本及整理資料(參考第 16 頁表 A 的資訊摘要)，每一個群落皆有可能包含第 17 頁表 B 所列的 17 種(A – Q) 中任何一種，在表 B 中亦包括每個物種其個體的平均新鮮生物量。

The abundance of each species in Community 1 and 2 is indicated with different-sized chips (see photograph below); e.g., there are 61 individuals of species A shown here:

在群落 1 及 2 中每一物種之豐度以不同大小的板塊表示(如下圖照片)，例如：物種 A 包括 61 個個體。

1 individual 1 個個體　　10 individuals 10 個個體　　50 individuals 50 個個體

- Determine the abundance of each species in Community 1 and record your data in Table 1 **in the Answer Sheet**.

  計算群落 1 內各物種的豐度，將答案填入**答案卷中**表 1 內

- Fill in the rest of the required information (to 2 decimal places) in the table. Please note that lg in the table and figure represents $\log_{10}$ and in the calculator, this is represented by the log button.

  將其他所需的資訊 (至小數第兩位) 亦填入表內，請謹記圖表中lg的符號係$\log_{10}$在計算機則以log鍵顯示。

- Repeat the entire procedure for Community 2.

  以同樣的方式來計算群落 2，將答案填入**答案卷中**表 2 內。

Q2.2 **(3 points × 4 = 12 points)** Using your data in Tables 1 and 2, as well as the data provided in Tables 3 and 4, plot the rank-abundance curves for Community 1 to 4 on Graphs 1 to 4 provided **in the Answer Sheet**.

(3 分 × 4 = 12 分) 用你表 1 和表 2 所得的資料以及表 3 和表 4 所提供的資料，畫出群落 1 到 4 的位序-豐度曲線**在答案卷**所提供的圖 1 至圖 4 中。

Answer the following questions **in the Answer Sheet**. Indicate correct answer(s) with a tick (✓) and incorrect answer(s) with a cross (**×**).

在答案卷上回答下列問題，若正確打勾(✓)，若錯誤打叉(**×**)。

Q2.2.1 **(1 point × 5 = 5 points)** Low evenness is:

(1 分 × 5 = 5 分) 低均勻度是：

a. indicated by a steep slope in the rank-abundance curve.

係指在位序-豐度曲線的斜率很大

b. shown in Community 1.

顯示於群落 1 中

c. shown in Community 2.

顯示於群落 2 中

d. shown in Community 3.

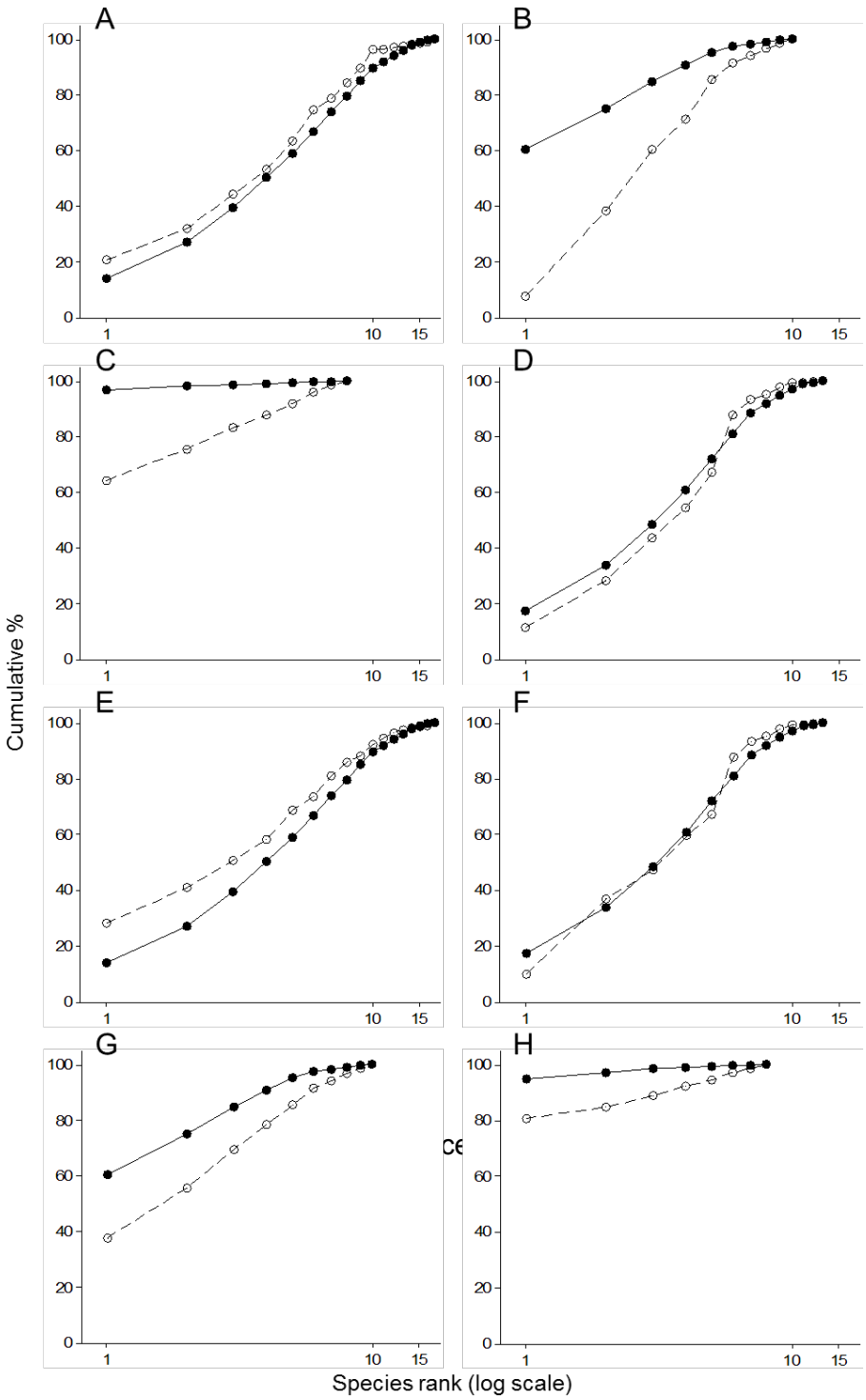
顯示於群落 3 中

e. shown in Community 4.

顯示於群落 4 中

Q2.2.2 **(2.5 points × 4 = 10 points)** Indicate the correct ABC curves (A – H) that correspond to Community 1 to 4.

(2.5 分 × 4 = 10 分) 指出與群落 1 至 4 相對應之正確ABC曲線(A – H)



Q2.2.3 **(1.5 points × 4 = 6 points)** Rank Community 1 to 4 in decreasing levels of disturbance.

(1.5 分 × 4 = 6 分) 將群落 1 至 4 依照干擾程度由大至小排序

Q2.2.4 **(1 point × 10 = 10 points)** A careless summer intern, mixed up the labels for the sampling stations (A1 – A3; B1 – B7) when the samples were transferred from leaking containers to new bottles. From which stations could the benthic samples containing Community 1 to 4 likely to be collected?

(1 分 × 10 = 10 分) 一位粗心的暑假實習生，將樣本(來自各樣站A1 – A3; B1 – B7)由會漏的容器移至新瓶時，貼錯了標籤。試問群落 1 至 4 最有可能由哪些樣站收集而來？

Q2.2.5 **(2.5 points)** Which of the 17 species (A – Q) is likely to be a bivalve?

(2.5 points)在A – Q的 17 種物種中，哪種最有可能屬雙枚貝類？

Q2.2.6 **(2.5 points)** Which of the17 species (A – Q) has the potential to be a bioindicator of organic enrichment?

(2.5 points) 在此 17 種物種中(A – Q)，哪一種有潛力成為指標生物，此指標生物可用來表示此環境中有機物是否添增？

Table A

Community 3

Species 種	Abundance 豐度	Rank 排序	Log_{10} (lg) Abundance	Cumulative % Abundance	Cumulative % Biomass
D	200	1	2.30	14.31	28.30
C	180	2	2.26	27.18	41.03
L	175	3	2.24	39.70	50.76
N	150	4	2.18	50.43	58.34
P	120	5	2.08	59.01	68.65
B	112	6	2.05	67.02	73.74
M	98	7	1.99	74.03	81.17
Q	80	8	1.90	79.76	86.02
O	75	9	1.88	85.12	88.29
E	62	10	1.79	89.56	92.36
F	35	11	1.54	92.06	94.40
H	30	12	1.48	94.21	96.45
A	28	13	1.45	96.21	97.44
G	25	14	1.40	98.00	98.45
J	15	15	1.18	99.07	98.48
I	8	16	0.90	99.64	98.99
K	5	17	0.70	100.00	100.00
Total	**1398**				

Community 4

Species	Abundance	Rank	Log_{10} (lg) Abundance	Cumulative % Abundance	Cumulative % Biomass
J	320	1	2.51	60.49	7.83
G	78	2	1.89	75.24	38.37
B	50	3	1.70	84.69	60.39
A	32	4	1.51	90.74	71.35
F	25	5	1.40	95.46	85.42
I	10	6	1.00	97.35	91.53
N	5	7	0.70	98.30	93.98
H	4	8	0.60	99.05	96.62
E	3	9	0.48	99.62	98.53
M	2	10	0.30	100.00	100.00
Total	**529**				

表 A 說明：Cumulative % Abundance 累計豐度% ； Cumulative % Biomass 累計生物量%

Table B. Fresh biomass per individual for species A to Q.

物種 A 至 Q 之個體新鮮生物量

Species 種	Mean resh biomass (g) 平均新鮮生物量 (g)
A	0.70
B	0.90
C	1.40
D	2.80
E	1.30
F	1.15
G	0.80
H	1.35
I	1.25
J	0.05
K	4.00
L	1.10
M	1.50
N	1.00
O	0.60
P	1.70
Q	1.20

END OF PAPER