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ОДЕСЬКИЙ ДЕРЖАВНИЙ ЕКОЛОГІЧНИЙ УНІВЕРСИТЕТ

**О.Ю. Куделіна, О.М. Соборова, Мітіна О.М.**

**НАВЧАЛЬНИЙ ПОСІБНИК  
з англійської мови  
для магістрів I року II семестру  
денної форми навчання  
(спеціальність “Водні біоресурси та аквакультура”)**

**Навчальний посібник**

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**Куделіна О.Ю., Соборова О.М., Мітіна О.М.**

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**Р е ц е н з е н т и:**

Завідувач кафедри англійської філології та перекладу Національного університету «Одеська політехніка»  
к.філол.н., доцент, Мітіна О.М.

Завідувач кафедри водних біоресурсів та аквакультури  
к.б.н., доцент Бургаз М.І.

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## ПЕРЕДМОВА

Навчальний посібник з англійської мови призначений для магістрів *І року II семестру* денної форми навчання зі спеціальності „*Водні біоресурси та аквакультура*”.

Мета запропонованого навчального посібника – на матеріалі наукової англійської літератури за фахом розвинути навички читання, перекладу, аналізу та переказу текстів. Майбутнім фахівцям потрібні навички практичного оволодіння іноземною мовою в різних видах мовленнєвої діяльності в обсязі тематики, зумовленої професійними потребами. Їм треба одержувати новітню фахову інформацію через іноземні джерела.

Навчальний посібник складається з **6 уроків**, де поданий відповідний граматичний матеріал за програмою, а також тексти, що відібрані з оригінальної науково-популярної та наукової літератури.

Тексти призначені для читання, усного перекладу, аналізу елементів тексту, анотуванню з подальшою перевіркою на занятті, уточненням значень окремих лексичних одиниць та переказу.

**Лексичні вправи** призначено для вивчення та закріплення лексичного матеріалу в кожному уроку та охоплюють лексику основних текстів.

**Граматичні вправи**, що подані у вигляді систематизованого комплексу з морфології відповідно до нормативного курсу граматики сучасної англійської мови, спрямовані на аналіз та відпрацювання, закріплення вивченого граматичного матеріалу. До окремих граматичних вправ використані уривки з текстів оригінальної англійської та американської літератур (Т. Драйзер, Ч. Діккенс, Дж. Голсуорсі, С. Моем, А. Крісті, Б. Шоу, Марк Твен та ін.), що поглиблюватиме розуміння особливостей морфології англійської мови.

Курс розрахований на 180 годин (на 75 годин аудиторної роботи та на 105 годин самостійної роботи студентів у II семестрі) і вивчається з метою удосконалення професійних знань і розвитку умінь використання цих знань у англійській професійній діяльності. Навчальний посібник також спрямований на розвиток умінь усної та писемної комунікації.

Після вивчення даного курсу студенти повинні знати і вміти:

- читати та перекладати науково-технічну англійську літературу за фахом для одержання необхідної інформації;
- розуміти зміст прочитаного та лексико-граматичний матеріал, наданий у методичних вказівках;
- розуміти і володіти відповідними граматичними конструкціями та матеріалом;
- брати участь в усному спілкуванні англійською мовою в обсязі матеріалу, передбаченого програмою.

# LESSON I

## Text

**Exercise 1. Translate the text using a list of unknown words.**

### **Fish Feed Intake, Feeding Behavior, and the Physiological Response of Apelin to Fasting and Refeeding**

Daniel Assan<sup>1,2,3,4,5</sup> Yanlin Huang<sup>1,2,3,4</sup> Umar Farouk Mustapha<sup>1,2,3,4</sup> Mercy Nabila Addah<sup>6</sup>  
Guangli Li<sup>1,2,3,4</sup> Huapu Chen<sup>1,2,3,4,5\*</sup>

<sup>1</sup>Fisheries College, Guangdong Ocean University, Zhanjiang, China

<sup>2</sup>Guangdong Research Center on Reproductive Control and Breeding Technology of Indigenous Valuable Fish Species, Guangdong Ocean University, Zhanjiang, China

<sup>3</sup>Guangdong Provincial Engineering Laboratory for Mariculture Organism Breeding, Zhanjiang, China

<sup>4</sup>Guangdong Provincial Key Laboratory of Pathogenic Biology and Epidemiology for Aquatic Economic Animals, Zhanjiang, China

<sup>5</sup>Southern Marine Science and Engineering Guangdong Laboratory, Zhanjiang, China

<sup>6</sup>Department of Fisheries and Aquatic Resources Management, Faculty of Bioscience, University for Development Studies, Tamale, Ghana

Feed is one of the most important external signals in fish that stimulates its feeding behavior and growth. The intake of feed is the main factor determining efficiency and cost, maximizing production efficiency in a fish farming firm. The physiological mechanism regulating food intake lies between an intricate connection linking central and peripheral signals that are unified in the hypothalamus consequently responding to the release of appetite-regulating genes that eventually induce or hinder appetite, such as apelin; a recently discovered peptide produced by several tissues with diverse physiological actions mediated by its receptor, such as feed regulation. Extrinsic factors have a great influence on food intake and feeding behavior in fish. Under these factors, feeding in fish is decontrolled and the appetite indicators in the brain do not function appropriately thus, in controlling conditions which result in the fluctuations in the expression of these appetite-relating genes, which in turn decrease food consumption. Here, we examine the research advancements in fish feeding behavior regarding dietary selection and preference and identify some key external influences on feed intake and feeding behavior. Also, we present summaries of the results of research findings on apelin as an appetite-regulating hormone in fish. We also identified gaps in knowledge and directions for future research to fully ascertain the functional importance of apelin in fish.

## **1 Introduction**

Food is one of the foremost expenses of intensive fish farming, which fish farmers need to pay much attention to. Its availability in quantity and

quality is significant for the appropriate growth and reproduction of fish. Feeding as determined by Metcalfe and colleagues plays a vital role in animal life-sustaining activities. Evidence has it that, the regulation of feed intake, as in mammals, is well conserved in vertebrates, including some fish species. The optimization of food intake can lead to enhanced growth and body composition, with increased food conversion efficiency and reduced nutrient losses, which are major objectives in intensive fish farming.

The intake of feed is known to be regulated by complex interactions between the brain and peripheral appetite-regulating hormonal factors, including apelin. As indicated by Volkoff and colleagues, when the endocrine mechanisms controlling food intake in fish is understood, it will not only lead to the explicit modifications in fish-holding situations and feeding approaches such as temperature and time of feeding respectively but rather, it will also help to develop new procedures to improve food conversion efficiency as well as aquaculture growth.

In the past years, less attention has been given to apelin in the regulation of feed intake in vertebrates. With its uncertain role in mammals as a feed intake regulator, apelin has been identified to play an orexigenic role in vertebrates such as fish. It aids in several regulation of biological activities in fish, which most importantly includes the regulation of food consumption. The goal of this review is twofold; firstly, to examine the recent advances in our understanding of the feeding behavior, focusing more on dietary selection and preference of fish as well as analyzing the influence that some external factors have on feed intake and behavior. Secondly, we gather information from previous research studies on apelin, categorizing its specific role in fish as an appetite-regulating hormone and identifying gaps in knowledge and directions for future research regarding this important topic.

## **2 Feed Intake and Feeding Behavior in Fish**

The result of food intake is the alteration that lies between starvation, craving, and satiation. Starvation is the physiological necessity for food, including a strong incitement to feeding behavior; looking for food and consuming it. Satiation is the physiological and rational sense of “fullness” that happens after food intake whiles appetite or craving, on the other hand, is the desire to eat, which is commonly related to the material (find, fragrance, taste) perceptiveness of the food to be consumed. Feed is among the most authoritative signals outside the fish’s body that can arouse feeding behavior and growth. Its readiness and composition exert a key control of these processes, by acting principally on the hormones responsible for their endocrine control (9). Some central and

peripheral appetite regulators in fishes are affected by a single meal, showing per-prandial fluctuations in their expression and/or secretion levels. Such changes in fishes have been identified in the brain hormone. The search for food and its intake in fish is girded by a series of behavioral acts matched through a supportive work between the nervous and endocrine systems. The control of feed ingestion behavior is a remarkable multifaceted development that comprises particularized interactions between the brain and marginal indications. The metabolic sensors located in the central nervous system of fishes provide room for the hypothalamic systems to receive nutritional information, allowing a qualitative control of food ingestion. The neural effectors of the hypothalamic origin facilitate the control of food consumed by the fish, thus, by integrating between hunger and satiety signals which include apelin and neuropeptide Y for hunger hints, and amylin and cocaine-and amphetamine-regulated transcript for satiety hints. As important as it is, it interests more fisheries and aquaculture firms in curbing fish growth and reproduction by changing food and/or endocrine settings.

Fish feeding behavior is miscellaneous and has been broadly examined in both wild and farmed fish from their ecological perspectives whiles behavioral responses of fish to feeding have been associated with feeding approaches, feeding habits, feeding regularity, feed detection mechanisms and feed preferences. Feeding behavior and its regulation in fish comprises of external and internal environment information being analyzed by signaling molecules and receptors in the fish. Thus, the hypothalamus, assisted by other brain sections in the fish, integrates inbound indications. As ascertained by Volkoff and colleagues, changes in dietary behavior and cravings are frequently related to changes in gene expression and/or protein content of the appetite regulators or their receptors. That is to say, changes in the mRNA/protein levels of a given hormone due to starvation or feeding have the probability of reflecting its physiological role in regulating feed ingestion. Nevertheless, it should be noted that, in the view of the multifactorial character of food regulation, there is a probability for compensative mechanisms in the manner or conduct of feeding to take place whiles fluctuations in available hormones might not essentially suggest variations in feed intake.

## **2.1 Dietary Selection and Preference in Fish**

Fish do not consume all the food items they come across. Dietary selection has been broadly explored in mammals, which lessen their consumption of an imbalanced diet to avoid negative dietary impacts. Nourishment choice is based on the preface that animals, such as fish, have “quality dietary insight” and

hence, select a diet that optimally restores a metabolic imbalance as a result of a nutritional challenge. Fishes are selective in the choice of food that contains the necessary nutrients for their survival, growth, and reproduction. This insinuates that fishes as in other animals have evolved from extraordinary diversity of means and challenges, being able to sense nutrients and the existence of precise hungriness to regulate the intake of specific nutrients. The source of nutrients can be recognized by gastrointestinal receptors during food digestion, as they are released interiorly in the stomach and pass into the digestive tract. Those receptors would trigger neural action and hormonal signals that would direct brain centers about the dietary properties of food and subsequently alter feeding behavior.

Nutrition is a very significant inward factor in fish, as the foremost determination of fish feeding is to satisfy the protein and energy requirements of the fish, relating to feeding behavior and feed consumption, and have the probability to unswervingly influence or impact the appetite of the fish, reflecting in its growth. Nutrients are biological composites involved in biochemical reactions that produce energy and are ingredients of cellular biomass. These nutrients have been categorized into two groups: macronutrients and micronutrients. Macronutrients are those that are required in comparatively large quantities since they are the key source to generate the energy required by organisms to live, grow, and reproduce. Micronutrients on the other hand are those needed in smaller quantities, even though they have several significant roles in cellular processes. The figure below gives examples of key macronutrients and micronutrients and their importance in feed (Figure 1). Detailed information on feed and nutrient requirements for fish can be found in a book from the National Research Council (NRC).

The quality of feed suggests the nutritional efficacy and the objective components of a feed making it pertinent to eat and digestible for the fish. Fish growth, good health, and maintenance are achieved only when the precise quantity of energy and vital nutrients are available in their adequate proportions in the feed, aiding in proficient feed intake. Response to feed intake, its tastiness, and digestibility differ as a result of the difference in fish feed components. Signifying that, fish farmers should access the quality of feed they provide for their fish since it plays a key role in it being accepted by the fish, how appetizing it is, and its digestibility. Similarly, the composition of a diet is an additional nutritional aspect of a feed that needs quality attention since it influences appetite-regulating hormones. While the literature available on this is insufficient as stated by Bertucci and colleagues, several research studies have it that, when macronutrients are changed in the diet composition of the fish, it has

a significant impact on either the secretion and/or the expression of appetite-regulating hormones. Thus, it's of great importance in fisheries and aquaculture since fluctuating diet and/or hormone milieu influence fish growth and reproduction.

Aside from the use of the 'feed intake' method which has extensively been used in animal nutrition, the use of 'self-feeders' in diet selection could be used as a great means to improve the understanding of the physiological approaches towards feeding behavior in fish. For example, studies on rainbow trout (*Oncorhynchus mykiss*) revealed that it could differentiate between diets varying in the vital amino acid content. It also showed that the fish had a precise preference for the whole diet over the balanced amino acids. Also, research conducted on self-selection of diets in sharp snout seabream (*Diplodus puntazzo*) and the Senegalese sole (*Solea senegalensis*) revealed that these species select macronutrients according to their dietary needs.

According to da Silva and colleagues, there are numerous benefits to offering animals a free choice of nourishment, which is considered the most biological and moderate way of providing feed for fish. With time, fish can learn to select specific feeds following their nourishing requirements, as well as self-feed. Equally, when the fish meets its goal of each specific nutrient consumption, it will provide its body with the optimal concentrations of nutrients required for proper growth and reproduction.

## **2.2 Extrinsic Factors Influencing Feeding and Feeding Behavior in Fish**

Generally, hunger stimulates the behavioral response of feeding fish. When feed is available, fish may initially feed at a faster rate and slowly decrease or stop with a gradual decline of appetite. Feeding behavior despite being influenced by intrinsic factors is extremely influenced by ecological or extrinsic factors. Below, we highlight some of these environmental factors that influence food ingestion and feeding behaviors in fish.

### **2.2.1 Stress**

Stress has been defined as the disturbance of physiological or biological mechanisms due to internal and external factors, which are generally designated as stressors. These provoke a cataract of consistent behavioral and biological rejoinders in which a living organism makes efforts to reestablish homeostasis, consequently incapacitating the threat. In an aquaculture firm, cultured fish are restricted, captured, crowded, sedated, held, and transported during repetitive husbandry. In consequence, all these taken into consideration are ordinary events in fish farming and they are possible stressors that interrupt the

behavioral and biological mechanisms of the organism. Thus, causing a functional response crucial to recover the dynamic consistency. Reduction in feed ingestion has been described to be distinctive behavioral feedback to stress in fish. Undeniably, stress can also disrupt several feeding conducts in fish, including the food search, finding, or capturing prey, leading to a decline in growth in several fish species. Fish under stressful conditions as compared to unstressed fish eat less and have slow growth. Even when food intake levels are maintained in fish, these conditions are known to persuade a decline in the conversion efficiency of feed consumed, leading to the decreased growth rate. For example; a research by Lee and colleagues revealed that acute physical stress caused by cleaning once or thrice a week reduced the daily and cumulative feeding levels and feed conversion efficiency significantly in the sea bass (*Dicentrarchus labrax*). Furthermore, these stressors have been known to adjust the control of endocrinal growth alliance in fish such as the secretion of pituitary growth hormone, among others. In the two subsections below, we discussed two key stressors that influence the well-being of fish, which needs keen attention.

#### **2.2.1.1 Temperature**

There have been several demonstrations of the relationship that exists between temperature and feeding in several fish species. Temperature is one of the most dominant factors influencing some key biological functions in fish, including feed ingestion and feeding behavior. Relatively, despite the complex and species-specific effects of temperature in fish, the relation between feeding/feeding behavior and temperature is like a bell-shaped structure; at normal temperature conditions, the voluntariness of food intake also increases and/or is maintained during the acclimatization period of temperature which is specific to a particular species. On the other hand, when there's a slight decrease in temperature, the fish adapts to the temperature and maintains its feeding rate for a short period. It has also been ascertained that before the ultimate maximal/minimal critical temperature for a species reaches, it will lose appetite, cease, and lastly stop feeding. See Figure 2. Examples given here revealed that, a research conducted on Atlantic cod (*Gadus morhua*) revealed that, when kept in a water temperature of 2°C for four weeks, there was a decrease in feed consumption compared to those kept in 11°C and 15°C water temperature. Also, research conducted on the red-spotted grouper (*Epinephelus akaara*) revealed that when the water temperature is around 25°C, there's an increase in its feeding and digestion level. However, it should be taken into consideration that when the optimal temperature of a particular fish species reaches and/or exceeds, it results in a gradual decline in feeding behavior.

### 2.2.1.2 Hypoxia

Dissolved oxygen (DO) is among the most significant extrinsic factors in fish farming. It is known to be a key restrictive factor in aquaculture with the particular reason for the circumstance being that, fish have aerophilic absorption which requires DO at efficient levels. The depletion of DO concentration (hypoxia) in water bodies has been identified to be a stern extrinsic stress, which commonly occurs in high-density aquaculture. Reports have indicated that growth, survival, behavior as well as other physiological activities of some fish species are highly influenced by different degrees of hypoxia and is also known to be an endocrine disruptor.

Fish under severe hypoxia conditions experience reduced movement or feed intake to conserve energy. In research conducted on the Atlantic salmon (*Salmo salar*) with regards to the hypoxic period and its physiological activities, results revealed that there were behavioral changes associated with oxygen shortage and physiological stress in some groups. Also, the severity of hypoxia reduced the intake of feed in the fish. In a research study on tilapia (*Oreochromis niloticus*) it was discovered that fish kept in hypoxic conditions had significantly reduced feed intake, survival rate, and weight gain. Additionally, a research study on rainbow trout (*Oncorhynchus mykiss*) demonstrated that hypoxia reduces feed consumption, growth rate, oxygen consumption, energy, and lipid contents. On the other hand, research conducted on tilapia (*Oreochromis niloticus*) comparing three DO (normal, low and medium) levels showed that, the final fish weight of those in the normal DO levels group were significantly higher as compared to those in the low and medium DO levels groups. Additionally, fish under the low DO level group demonstrated a lower feed intake rate. The low DO level group also revealed that fish in this group had a lower growth and feed utilization rate. This significantly demonstrates that when fed under enough DO levels, fish show good efficiency of their feed intake, which will most importantly aid in good feed conversion ratio, fish growth and reproduction in the absence of any other stress. Hypoxia has been discovered to persuade primary, secondary, and tertiary stress responses in fish. However, most fishes can adapt to the variations in DO levels but if severe hypoxia remains, fish will sooner or later die.

Cultured fish always face repetitive and chronic hypoxia stress especially from overcrowding which they can barely escape due to their confined environment. Therefore, it is suggested that DO levels should be checked and highly maintained near the saturation level. In doing so, it enhances feed intake, feeding behavior, fish growth as well as improves the overall wellbeing and

performance of the fish, as the result of hypoxia on the biological or metabolic actions of farmed fish would be negatively affected. A deep look into an article by Abdel-Tawwab and colleagues gives more insight into the effects of hypoxia on fish growth and physiological activities.

### **2.2.2 Photoperiod and Light Regime**

Photoperiod has been known to influence and manipulate some biological functioning in fish. Research conducted on several fish species have revealed that photoperiod and the light regime influence their feeding activities. Photoperiod plays a significant part in the growth and survival of fish, thus influencing its feed intake and feeding behavior. It is known to have the ability to affect the general wellbeing and routine of fish.

The requirements of photoperiod and light concentration in fish are species-specific and differ for the several developing phases. Consequently, while this could be related to fish species specificity, when photoperiod is appropriately applied, it may aid in an advanced performance of the fish, thereby improving the productivity and sustainability of aquacultural practices. For example, a research study conducted on catfish (*Clarias gariepinus*) fingerlings cultured under three different photoperiod conditions; 24 hours (hrs) darkness, 24hrs light and 12/12hrs darkness and light revealed that those cultured under 24 hrs of darkness had significantly highest feed intake, best feed conversion ratio and lowest quantity of uneaten feed as compared to those cultured under 24hrs light and 12/12 hrs of darkness and light. Also, in a research study on the pacamã catfish (*Lophiosilurus alexandri*), it was revealed that 24hrs continuous light led to the highest feed intake. Going more further, in research conducted on the sharp-snout seabream (*Diplodus puntazzo*) it was concluded that although feeding behavior was strictly diurnal, 97% of feed demands were made during the light periods. A detailed look into how photoperiod affects fish species feed intake and feeding behavior will be of much importance.

### **2.2.3 Circannual and Circadian Rhythms**

All these external factors that impact the feeding behavior in fish have periodic or recurring styles. Thus, they affect food intake unswervingly via cyclical and or 24-hourly rhythms or ramblingly through rhythms in endocrine systems. All animals, even fish, showcase natural behavioral rhythms, including the two principal feed intake rhythms in fish; the daily (circadian) and seasonal (circannual) rhythms.

Several organisms including fish, exhibit annual rhythms in physiological and behavioral factors, such as feeding, reproduction, body weight, hibernation, and

movement. These factors are controlled by oscillations in the secretion of hormones. The timing of these annual rhythms is delimited by changes in day length, photoperiod, or temperature, which makes available a reliable and predictive indicator of seasonal changes in environmental conditions. The circannual (seasonal) rhythms in vertebrates (fish) associate meticulously with ambient environmental factors, thus environmental (water) temperature and the length of the day. During the spring and summer seasons, when the days are longer and the temperature of water bodies is higher, several fish species increase their feed intake as well as their feeding behavior. There is limited information on how these seasonal or circannual rhythms influence feed ingestion and feeding behavior in fish, making it complex to give a straightforward conclusion about feeding activities and associated seasonal changes. As it stands now, we recommend that more research be conducted on fish feeding and feeding behavior regarding the impact of the circannual rhythms.

The circadian rhythm is a natural rhythm that is regulated by a biological daily clock that proceeds in a steady setting. This biological clock is a 24-hour cycle in the biochemical, physiological, or behavioral processes of a live organism geared for maximizing cellular activities and recognizing solar day-related environmental obstacles. The 24-hourly rotations of behavior and physiology (example; feeding activity) have been established in all classes of craniates, including some fish species. Several inward or endogenic clocks prompt these circadian cycles. They consist of an independent transcriptional-translational response grummet that encompasses the recurring circadian-regulative genes expression and perseveres under continuous extrinsic circumstances, such as photoperiod.

As in many animals, fish species consume meals at specific times during the day or night. That is to say that in fish circadian rhythms, the natural daily food ingestion times differ among species. Some classify specifically as daytime feeders such as Atlantic salmon, *Salmo salar*, redbelly tilapia (*Tilapia zillii*) rohu (*Labeo rohita*), and common carp (*Cyprinus carpio*) while others are described as night time feeders, example; European catfish (*Silurus glanis*) and Zebrafish (*Danio rerio*). Additionally, several fish species have showcased ideal times of eating daily (day or night). For example, research studies conducted on goldfish (*Carassius auratus*) and rainbow trout (*Oncorhynchus mykiss*) respectively revealed that the intake of food and the composition of the body is influenced by the time a single daily meal is delivered while rainbow trout (*Oncorhynchus mykiss*) fed during their habitual or natural eating times have higher feed efficiency.

There are approximately a handful of known genes or hormones which regulate feed intake in fish species, including neuropeptide Y, peptide YY, ghrelin, galanin, apelin, among others. These appetite-regulating genes influence the intake of feed in two ways; feed intake inducer or inhibitor. The appetite-inducing hormones persuade or signal hunger in fish, thus causing them to search for food to eat (orexigenic factor). On the other hand, appetite-inhibiting hormones are the hormones in fish that signal their satisfaction (anorexigenic factor). Several external and internal factors affect the display of this physiological role in feed intake regulation in fish with regards to their specificity. As such, these factors regulate the roles of the gene either by playing opposite roles or not affect the fish at appropriate times. Below, we elaborate more and present summaries of the results of research findings on apelin as an appetite-regulating hormone in fish.

### **3 Apelin and Its Physiological Role in Regulating Feed Intake in Fish**

#### **3.1 Isolation and Characteristics of Apelin**

Apelin is a 36-amino acid (AA) peptide that was initially isolated from bovine stomach extracts. It is a recently discovered peptide known as a ligand for the APJ receptor, a putative receptor protein related to the type-1 angiotensin receptor, and a member of the family of seven transmembrane domains G-protein-coupled receptors (GPCRs). From the findings of researches conducted by the research teams of Langelaan and Malyszko, it revealed in mammals that, a 77 AA precursor, prepro-apelin, gives rise to numerous forms of apelin, which can be composed of 13–36 AA residues, thus 36, apelin-17, and apelin-13.

The apelin receptor, also called APJ or angiotensin receptor-like-1 which is currently known as the common receptor for apelin was primarily cloned in 1993 due to its robust sequence homology with the angiotensin II receptor (AT1) (54% in transmembrane spheres and 31% for the complete sequence) but APJ does not bind angiotensin II. It is known to be an orphan G-protein-coupled receptor that was originally secluded from a human genomic collection using the polymerase chain reaction (PCR). Apelin which was originally described as an endogenous ligand for APJ as stated by secreted as a 77 amino acid forerunner, prepro-apelin, which is differentially processed producing numerous smaller peptide fragments, which comprises apelin-12, apelin-13, apelin-17, apelin-36.

#### **3.2 mRNA Expression of Apelin in Fish Tissues**

Several research studies have revealed the presence of the apelin gene (apelin) in several tissues of some fish species such as the goldfish (*Carassius auratus*) red-bellied piranha (*Pygocentrus nattereri*) and cunner (*Tautoglabrus adspersus*)

these include different brain regions such as the ladder, optic tectum/thalamus, olfactory bulbs, and the hypothalamus. It can also be found in the pituitary, as well as the peripheral tissues in the fish; spleen, kidney, liver; muscle, brain, gut, gonad, gill, and heart, with seemingly higher expression levels in spleen, kidney, brain, gonad, gill, and heart. Although weakly expressed, apelin was also identified in the hepatopancreas, eye, intestine, and skin of the Ya-fish (*Schizothorax prenanti*). Also, in *Schizothorax davidi*, apelin mRNA was expressed in the spleen and heart, considerable levels in the brain (myelencephalon and telencephalon), liver, and trunk kidney, and *Pirapitinga*, *Piaractus brachipomus*, apelin mRNA expression was revealed in the liver, stomach, pyloric caeca, foregut, hindgut, kidney, gill, skin, and muscle as well as in the brain and pituitary.

### **3.3 Non-Appetite Regulatory Role of Apelin**

Apelin is known to control cardiovascular functions in mammals, including blood pressure and blood flow. The apelin/apj system plays important and several roles in the physiology and pathophysiology of many organs, including the regulation of blood pressure, cardiac contractility, among others. It is known to be one of the most effective stimulators of cardiac contractility yet discovered and plays a role in cardiac tissue renovation in vertebrates.

### **3.4 Apelin as an Appetite-Regulating Hormone in Fish**

Apelin, which has an uncertain role in the regulation of feeding in mammals is known to act as an orexigenic factor and might have several biological regulating roles in fish. Either its peripheral and/or central injections increased food intake in fish species that have been studied. For example; research conducted on the blind cavefish, *Astyanax fasciatus mexicanus* revealed that peripheral injection of apelin significantly increased food intake of the fish as compared to saline injections. In goldfish (*Carassius auratus*) both intraperitoneal (i.p.) and intracerebroventricular (i.c.v.) injection of apelin-13 revealed an augmentation of its food intake. Also, in the Siberian sturgeon (*Acipenser baerii*) continuous i.p. injection of apelin demonstrated an increase in feed ingestion. Additionally, apelin i.p. injection in Ya-fish (*Schizothorax prenanti*) also stimulated the intake of feed.

### **3.5 The Response of Apelin to Fasting and Refeeding in Fish**

Several hormones in fish as in other vertebrates control the intake of food. These hormones, known as appetite-regulating hormones are produced from the brain and or other marginal tissues in the body of the fish. These appetite-regulating hormones play roles either as a food inducer or inhibitor. Apelin's role on food

intake in vertebrates like teleost is poorly understood. Nonetheless, researches have been conducted to find out the role that apelin plays in some fish species' food intake, either as an orexigenic or an anorexigenic indicator. Here, we elaborate more on its response to feeding and fasting, indicating which role it fits well into.

Research conducted on common carp (*Cyprinus carpio*) discovered that starvation resulted in a significant upsurge in hypothalamus apelin and expression of APJa mRNA. It then returned to normal levels after the fish were refed. Also, the expression of APJb mRNA augmented after temporary starvation, thus within 2 and 4 days; nevertheless, there was no significant difference between fed fish and refed fish even after the starvation was prolonged. From this same research, there was a significant increase in apelin, APJa, and APJb mRNA expression levels in the foregut of the common carp, which then returned to normal levels after refeeding, either after a short-term or long-term fast. It was discovered from a research study that the abundance levels of apelin mRNA were greater in starved goldfish than in fed goldfish (*Carassius auratus*) in both hypothalamus and telencephalon. Another research study also revealed that apelin mRNA levels in the whole brain were higher at 1 hr after feeding than that of unfed Siberian sturgeon (*Acipenser baerii*). However, its expression returned to normal levels at 3 hrs after feeding. In this same research study, it was revealed that apelin has bidirectional effects on feeding regulation in the Siberian sturgeon (*Acipenser baerii*) thus, apelin acts as a satiety factor in the short-term feeding regulation and a hunger factor in long-term feeding regulation. Moreover, in research conducted on *Schizothorax davidi*, it was concluded that apelin expression of fed fish at + 1 hr and + 3 hrs after feeding was lower than that of unfed fish, and apelin expression in the hypothalamus of unfed fish augmented on the 5th and 7th days and when fasting fish were re-fed, apelin mRNA expressions disclosed a notable decrease from the 9th to the 14th day concerning the fed group. Furthermore, in the red-bellied piranha (*Pygocentrus nattereri*) fasting induced a significant increase in the mRNA expression of apelin in the brain.

Research conducted on Ya-fish (*Schizothorax prenanti*) revealed that there was about 2.5 and a 2-fold decrease in apelin mRNA expression in the hypothalamus of fed fish at 1 hr and 3 hrs post-feeding compared to unfed controls, respectively. Both the levels of apelin and APJ mRNA expressions had a decreasing trend hours before feeding. In this same research, concerning food deprivation, food-destitute Ya-fish (*Schizothorax prenanti*) had a noteworthy change of about 1.8-fold higher mRNA expression levels of apelin than 3, 5 and 7 days habitually fed controls. The mRNA expression of apelin was significantly

decreased when 7-day fasted Ya-fish (*Schizothorax prenanti*) were re-fed, and the levels of the 7-day fed control group and fasted group of Ya-fish (*Schizothorax prenanti*) had an about 1.5- and 2.5-fold higher than the 7-day re-fed fish, respectively.

To sum up, the role of apelin is highly attributable to appetite regulation in fish. That is to say, the apelin hormone in starved or unfed fish induces hunger (up-regulated) and thus, persuades the fish to go after or search for its meal and there's a gradual or complete decrease in the expression of apelin as the fish eats or post-eating. A referral to Figure 1 in an article publish by Assan and colleagues gives a clear clue on the existing relationship between appetite-inducing genes and appetite-inhibiting genes.

### **3.6 The Interactions of Apelin With Other Appetite-Inducing Hormones in Fish**

Recent researches have demonstrated that individual orexigenic molecules or hormones interact with each other. For example, in cavefish, *Astyanax fasciatus mexicanus*, apelin i.p. injections increased orexin brain expression but did not affect either cholecystokinin or cocaine- and amphetamine-regulated transcript expression, suggesting that apelin might increase food intake through the stimulation of the orexin system in cavefish. Additionally, it was demonstrated by in vitro and in vivo experiments that apelin could persuade important mRNA expression levels of appetite-related and growth-related genes, including neuropeptide Y, agouti-related peptide, and orexin. This suggests that apelin has the potential to control the food intake and development of common carp by regulating the expression of these vital genes.

### **3.7 Characteristic Similarities Within Appetite-Regulating Hormones**

Besides the fish-species-specificity and other intrinsic and extrinsic factors antagonizing appetite-regulating hormones from exerting their full function on regulating feeding in teleost and other fish species, other genes play the same specific role in feed regulation in fish as apelin does. See Table 2 for a list of other appetite-inducing hormones in fish.

Generally, appetite-inducing hormones (hunger or orexigenic hormones) serve as hunger signals, causing an increase in feed ingestion. That is to say, fasting or starvation causes an up-regulation of these appetite-inducing hormones in fish, for example; ghrelin, neuropeptide Y and orexin. On the other hand, appetite-inhibiting hormones (satiety or anorexigenic hormones) cause a reduction in food intake, thus fasting or starvation does not affect their expression but rather feed intake causes an up-regulation of these appetite-inducing hormones. Thus,

appetite-inhibiting hormones in fish demonstrate pre-prandial decreases and postprandial increases in their concentrations. Example; peptide YY, cholecystokinin, and cocaine- and amphetamine-regulated transcript.

It has been demonstrated that the peripheral or central orexigenic hormone injections in fish persuade a significantly increase in food consumption rate as indicated in some research studies. Also, experiments demonstrating the acute and or chronic effect of anorexigenic hormone injections on either peripheral tissues or the brain of some fish species revealed that there were significant reductions in food ingestion for a short period in the acute and a long period all through the whole experiment for the chronic injection. Examples of such experiments include those conducted by.

#### **4 Conclusion**

Data available on fish feeding regulations indicate that the fundamental mechanisms in regulating feeding behavior are conserved. Our knowledge about how extrinsic factors influence feed ingestion and feeding behavior has been simplified. However, it appears that the general scheme of feeding regulation in fishes is similar to that of other vertebrates in the sense that hunger and feeding are controlled by central feeding centers that are influenced by endocrine factors rising from both the brain or from marginal tissues. As a whole, we believe there is still limited information available in fish compared with other organisms regarding how these extrinsic factors influence fish feeding and feeding response.

The role of apelin is highly attributable to appetite regulation in fish species that have been studied. To date, most researches conducted on appetite-regulating hormones in fish species have been relatively short-term studies, thus, making it difficult to establish a relation between short-term and long-term appetite-related factors. Fish have been known to exhibit a wider range of feeding behaviors, feeding habits, and feeding adaptations, including fasting or starvation periods. Here we suggest research to be advanced on the mechanisms regulating feeding and appetite-regulating hormones and genes in fish. Also, research on the response of apelin to feeding, fasting, and re-feeding should be conducted based on the influence of these extrinsic factors, adding up to the existing studies.

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**Exercise 2. Translate and study the following words and expressions:**

Post hoc, external, stimulate, intake, efficiency, cost, efficiency, connection, peripheral, unify, consequently, release, appetite-regulating genes, eventually, to induce or hinder appetite, apelin, peptide, receptor, extrinsic factors, behavior, decontrolled, brain, appropriately, fluctuations, in turn, decrease, food consumption, advancements, dietary selection, photoperiod, fish species, reveal light regime, survival, requirements, to differ, developing phases, to improve, the productivity and sustainability of aquacultural practices, catfish, to conclude, diurnal, to demand, vertebrates, marginal, a food inducer or inhibitor, an orexigenic or an anorexigenic indicator, to elaborate, starvation, a significant upsurge, fed fish and refed fish, abundance levels, hypothalamus, telencephalon.

**Exercise 3. Answer the questions:**

1. What is the main sense of the text?
2. What stimulates fish feeding behavior and growth?
3. What determines efficiency and cost, maximizing production efficiency in a fish farming firm?
4. What has a great influence on food intake and feeding behavior in fish?
5. What is known to be regulated by complex interactions between the brain and peripheral appetite-regulating hormonal factors, including apelin?
6. What groups of nutrients have been categorized into?
7. What are nutrients?
8. How is stress defined?
9. What does hunger stimulate?
10. What way does temperature influence fish?
11. What are fish dietary selection and preference?
12. What do you know about photoperiod and light regime?
13. What is an endocrine disruptor?
14. What can you say about circannual and circadian rhythms?
15. What are extrinsic factors influencing feeding and feeding behavior in fish?
16. What is the circadian rhythm?
17. What is apelin?
18. What is the role of apelin?

19. What is the response of apelin to fasting and refeeding in fish?
20. What are characteristic similarities within appetite-regulating hormones?

**Exercise 4. Make up as more sentences as you can, using the words and expressions from exercise 2.**

**Exercise 5. Make up 25 different type questions for the text.**

**Exercise 6. Write a brief summary of the text.**

*Note that:*

- A summary begins with an introductory sentence that states the article's title.
- A summary must contain the main thesis or standpoint of the text, restated in your own words.
- A summary is written in your own words.
- A summary is always shorter than the original text, often about 1/3 as long as the original.

**Exercise 7. Read your summary of text to your groupmate and ask him to retell it.**

**Exercise 8. Make up a plan of this text. Retell the text according to it.**

## **GRAMMAR**

### **The infinitive**

The infinitive is the base of a verb. They usually refer to the present infinitive, which is most common. There are four other forms of infinitives – the perfect infinitive, perfect continuous infinitive, continuous infinitive, and the passive infinitive. For instance;

*To err is human.*

*She refused to obey the orders.*

*Many men desire to make money quickly.*

It will be seen that the infinitive is a kind of noun with certain features of the verb, especially that of taking an object (when the verb is transitive) and adverbial qualifiers. In short, the infinitive is a Verb-Noun.

The word *to* is frequently used with the infinitive, but is not an essential part or sign of it. Thus, after certain verbs (*bid, let, make, hear*), we use the infinitive without 'to'. For instance, in the following statements;

*I saw her do it.*

*Let her sit here.*

*I made him run.*

*I bade her go.*

The infinitive without 'to' is also used after the verbs 'will, would, should, shall, might, may, could, can and must'. Consider the following examples;

She will *pay* the bill.  
 He *should* work harder.  
 You *must* come to the office at nine tomorrow.

| Verbs Followed by an Infinitive      |          |          |          |          |
|--------------------------------------|----------|----------|----------|----------|
| She agreed to speak before the game. |          |          |          |          |
| agree                                | consent  | have     | offer    | shoot    |
| aim                                  | continue | hesitate | ought    | start    |
| appear                               | dare     | hope     | plan     | stop     |
| arrange                              | decide   | hurry    | prefer   | strive   |
| ask                                  | deserve  | intend   | prepare  | swear    |
| attempt                              | detest   | leap     | proceed  | threaten |
| be able                              | dislike  | leave    | promise  | try      |
| beg                                  | expect   | like     | propose  | use      |
| begin                                | fail     | long     | refuse   | wait     |
| care                                 | forget   | love     | remember | want     |
| choose                               | get      | mean     | say      | wish     |
| condescend                           | happen   | neglect  |          |          |

### Uses of the Infinitives:

The infinitives may be used like a noun, with or without adjuncts in the following cases, it is known as simple infinitive:

1. As the subject of a verb in a sentence. For instance;

To *find* fault is easy.  
 To *err* is human.

2. As the complement of a verb, the infinitive can be used. For instance;

His greatest pleasure is *to sing*.  
 Her custom is *to ride* daily.

3. As the object of a transitive verb. Such as;

I do not mean *to read*.  
 She likes *to play* cards.

4. As the object of a preposition, the infinitives are used. For example;

She had no choice but *to obey*. (here, but means 'except')  
 The speaker is about *to begin*.

5. As an objective complement, infinitives are used. For instance in the following sentence;

She saw him *go*.

When the infinitive is used in following ways, it is known as the Gerundial or Qualifying Infinitive:

1. To qualify a verb, usually to express a purpose. Such as in the following examples;

She called *to see* my brother. (means for the purpose of seeing my brother).

I come *to bury* Caesar. (indicates the purpose).

2. To qualify an Adjective, as indicated in the following examples;

Prunes are good *to eat*.

The girls are anxious *to learn*.

3. To qualify a sentence, infinitives are used, as shown in examples below;

*To tell* the truth, I quite forgot my promise.

She was petrified, so *to speak*.

4. To qualify a noun, infinitives are used in following manner;

She is a woman *to be admired*.

You will have cause *to repent*.

The infinitives can be active or passive. When infinitive is used as **active**, it may have a present and a perfect form. And may merely name the act, or represent continued action. For instance;

Present: 'to love'

Perfect: 'to have loved'

Present Continuous: 'to be loving'

Perfect Continuous: 'to have been loving'

As Passive, the infinitives have a present and a perfect form only. For example;

Present: 'to be loved'

Perfect: 'to have been loved'

### **Grammar exercises**

**Exercise 1. Put "to" in front of the infinitive where it is necessary.**

1. He likes ... play football. 2. She can ... speak English. 3. We let them ... go there. 4. Don't help her ... do it. 5. May I ... take your dictionary? 6. He made me ... do it. 7. Mother let us ... swim in the river. 8. I don't want ... see him. 9. We would rather ... go home. 10. They wanted ... speak to us. 11. Would you like ... drink? 12. You had better ... take this medicine. 13. They couldn't ... find their child. 14. It's time ... go for a walk. 15. I'd like ... believe you. 16. We were ready ... go out. 17. My parent's didn't let me ... go to that party. 18. Do you like ... dance? 19. Would you like ... listen to my song? 20. His joke made me laugh. 21. I think I can't ... help you. 22. We had better ... say it at once. 23. May I ... come in? 24. He likes ... watch television. 25. Jane couldn't ... open the door. 26. Tom works because he needs ... eat. 27. He isn't going ... answer my question. 28. You would rather not ... tell them the truth. 29. I heard him ... sing. 30. I'm planning ... visit Rome. 31. The children were not allowed ... eat an ice-cream.

32. She said she would sooner ... stay in the city.

**Exercise 2. Choose the correct form (infinitive with or without to).**

1. I can (speak / to speak) English. 2. We have (do / to do) our homework. 3. You must (to stay / stay) at home. 4. I will to (help / help) you. 5. He cannot (see to / see) us. 6. My little sister learns (to speak / speak). 7. They want (go / to go) to the cinema. 8. You should (ask / to ask) your parents. 9. I'd like (have / to have) a dog. 10. May we (come / to come) in? 11. I failed (to persuade / persuade) my boss to give me a rise. 12. I need (change / to change) tires on my car. 13. He hates (get up / to get up) early. 14. I hope (to have / have) better luck next time. 15. Would you prefer (have / to have) dinner now or later?

**Exercise 3. Read the first sentence, and choose the most suitable verb to complete the second sentence.**

1. "Ellie, would you like to come to my party?"  
Ellie's friend *invited* / *instructed* / *obliged* her to go to the party.
2. "Mum, will you let me go to the party?"  
Ellie *encouraged* / *begged* / *asked* her mum to let her go to the party.
3. "Please, please, please mum, PLEASE let me go to the party!"  
She *forced* / *begged* / *persuaded* her mother to let her go to the party.
4. "Ellie, you are absolutely NOT allowed to go to the party."  
Ellie's mum *forbade* / *forced* / *allowed* her to go to the party.
5. "Now go upstairs and do your homework."  
Ellie's mum *advised* / *trained* / *ordered* her to go upstairs and do her homework.
6. "And don't forget to tidy your room"  
Ellie's mum *reminded* / *begged* / *instructed* her to tidy her room.
7. "Don't forget to clean under the bed, or there will be trouble!"  
Ellie's mum *advised* / *warned* / *encouraged* her not to forget to clean under the bed.

**Exercise 4. Read the first sentence. Then rearrange the words and phrases to complete the second sentence.**

For each sentence, there are 2 words that you **do not need to use**!

1. "Remember you have to pick your jacket up from the dry cleaner's."  
... .. to the dry cleaner's.  
*to warned she me ordered reminded go*
2. "It's really hot in here. Would you mind opening the window?"

- ... .. the window.  
*he asked begged her ordered open to*
3. "Would you like to have dinner with us on Friday?"  
 He ... .. with them on Friday.  
*invited persuaded commanded have them to inner*
4. "We'd be delighted if you could all be with us at the ceremony"  
 They ... .. attend the ceremony.  
*warned their reminded to invited friends all*
5. "Well, if I were you I'd start saving up for my holiday."  
 ... .. saving up for my holiday.  
*started me advised advise start he to*
6. "Don't drive too fast. The police are cracking down on speeding."  
 He ... .. too fast.  
*drove warn not to warned drive him*
7. "He's just bought a car, so I can visit her any time"  
 Buying a car ... .. her any time.  
*reminded visited has enabled him visit to*
8. "Come on, it's about time you looked for a new job, you know!"  
 Jack ... .. a new job.  
*look to me encourage encouraged look for*

**Exercise 5. Complete the sentences so that the meaning is similar to the first sentence.**

*Examples: I hope the bank will lend me a thousand pounds.*

***I want the bank to lend me a thousand pounds.***

*We were surprised that Manchester United lost the match.*

***We didn't expect Manchester United to lose the match.***

1. We would be very happy if you came on holiday with us.  
 We would love \_\_\_\_\_
2. Kevin said that I could ride his horse.  
 Kevin allowed \_\_\_\_\_
3. I was surprised that the bill was so expensive.  
 I didn't expect \_\_\_\_\_
4. Don't let me forget to buy some more milk.  
 Remind \_\_\_\_\_
5. Jennifer hopes her boss will give her an award.  
 Jennifer wants \_\_\_\_\_
6. George said to me "Please don't worry".  
 George told \_\_\_\_\_
7. Dad said I must not go on my boyfriend's motorbike.  
 Dad forbid \_\_\_\_\_
8. Shirley gave him singing lessons.  
 Shirley taught \_\_\_\_\_

**Exercise 6. Put the infinitives into the right form.**

1. He seems (to read) a lot. 2. He seems (to read) now. 3. He seems (to read) since morning. 4. He seems (to read) all the books in the library. 5. I want (to take) you to the concert. 6. I want (to take) to the concert by my father. 7. She hoped (to help) her friends. 8. She hoped (to help) by her friends. 9. I hope (to see) you soon. 10. We expect (to be) back in two days. 11. He expected (to help) by the teacher. 12. The children seem (to play) since morning. 13. I am glad (to do) all the homework yesterday. 14. She seems (to work) at this problem ever since she came here. 15. I am sorry (to break) your pen.

**Exercise 7. Join the elements of a Subjective Infinitive construction. Use the proper form of the verbs.**

*Example: He – to fall in love with her. (to be sure) He is sure to fall in love with her.*

1. They – to enjoy the film much. (to appear) 2. Tom – to catch the train. (to happen) 3. Ann – to be married. (to prove) 4. She – to have lost her money. (to turn out) 5. Her classmates – to be having a test. (to seem) 6. Jill – to have been badly injured in a car accident. (to say) 7. The concert – to begin at 8. (to report) 8. Her husband – to get a pay increase next month. (to expect) 9. The man – to have told the police about the accident. (to believe) 10. We – to phone him at work. (to suppose) 11. Your sister – to have behaved foolishly. (to think) 12. His father – to be in hospital now. (to know) 13. She – to take sleeping tablets. (to allow) 14. I – to miss the lecture. (to let) 15. He – to leave his job. (to force) 16. My boss – to sign the contract. (to make) 17. He – to paint the door. (to see) 18. The boys – to swear. (to hear) 19. The two men – to have broken the window. (to discover) 20. His visa – to be no longer valid. (to find) 21. They – to find a job at the moment. (to be unlikely) 22. All my group mates – to pass the exams. (to be likely) 23. George – to recognize you. (to be sure) 24. The secretary – to type your letters on time. (to be certain).

**Exercise 8. Put the infinitives into the right forms.**

1. Is there anything else (to tell) her? I believe she deserves (to know) the state of her sick brother. 2. He seems (to know) French very well: he is said (to spend) his youth in Paris. 3. The women pretended (to read) and (not to hear) the bell. 4. You seem (to look) for trouble. 5. It seems (to snow) heavily since early morning: the ground was covered with a deep layer of snow. 6. They seemed (to quarrel): I could hear angry voices from behind the door. 7. Perhaps it would upset her (to tell) the truth of the matter. 8. The only sound (to hear) was the snoring of grandfather in the bedroom.

**Exercise 9. Use the appropriate form of the Infinitive as a part of a compound verbal predicate.**

*Example: The boy is sure (to punish) for what he's done. The boy is sure to be punished for what he's done.*

1. I happened (to pass) by your house when I heard the noise. 2. Where's Jim? He seems (to leave). 3. You look so flushed. You seem (to run) a high temperature. 4. It's so nice here. Everybody appears (to enjoy) the party. 5. The storm is reported (to cause) much damage and (to kill) many people. 6. The public was reported (to give) a warm reception to the pop group. 7. Our yachtsman Konyukhov is said (to visit) many countries on his way round the world. 8. He is also known (to conquer) Mount Everest, the highest in the world. 9. He is known (to set) some world records. 10. Look, it's raining again. It seems (to rain) for ages. 11. The weather isn't likely (to change) for the better today. 12. Why are you here? You seem (to forget) about your appointment with the dentist who is certain (to wait) for you now. 13. This was the moment that seemed (to mark) the start of the interview. 14. She seemed (to listen) carefully to what he said. 15. Such idle talk was little likely (to reach) the ears of Mr. Dombey.

**Exercise 10. Translate into English.**

1. Мені дуже прикро, що я пропустив цю цікаву лекцію. 2. Він дуже задоволений, що закінчив свою книгу. 3. Наші спортсмени пишаються тим, що виграли кубок. 4. Він попросив, щоб його провели в актову залу. 5. Я тільки хочу, аби мені дозволили допомогти вам. 6. Я був вдячний, що мені дали кімнату з великим вікном. 7. Він був щасливий, що повернувся додому. 8. Він був щасливий, що знов вдома. 9. Мені прикро, що я перервав вас. 10. Джейн була щаслива, що їде від місіс Рід. 11. Рис був радий познайомитись з Джейн. 12. Рис був радий, що познайомився з Джейн.

**Exercise 11. You are planning a trip to Paris or London. As you have only a few days off, you decide to fly there. What are you going to do? Use suggested words and phrases and add something of your own.**

*Example: to choose a flight – First of all I'm going to choose a most suitable flight.*

to choose an airline; to get a visa; to look up the time-table; to make a reservation; to book the ticket beforehand; to pack the luggage; to take a taxi to go to the airport; to go through the customs; to submit the passport at the passport control; to check (by the security service); to go to the departure lounge

and wait there till the flight is announced; to have a good book to read on the plane.

**Exercise 12. Translate into English using the correct form of the Infinitive:**

1. Я радий, що розповів вам цю історію. 2. Я радий, що мені розповіли цю історію. 3. Я хочу познайомити вас з цією людиною. 4. Я хочу, щоб мене познайомили з цією людиною. 5. Я радий, що зустрів її на станції. 6. Я радий, що мене зустріли на станції. 7. Ми дуже щасливі, що запросили його на вечір. 8. Ми дуже щасливі, що нас запросили на вечір. 9. Він буде щасливий відвідати цю знамениту картинну галерею. 10. Він був щасливий, що відвідав цю знамениту картинну галерею. 11. Діти люблять, коли їм розповідають казки. 12. Я не думав зупинятися на цій станції. 13. Я не очікував, що мене зупинять. 14. Мені прикро, що я спричинив вам стільки клопоту. 15. Він не виносить, коли йому брешуть. 16. Я згадав, що вже зустрічав це слово в якійсь книзі. 17. Мені дуже шкода, що я пропустив цю цікаву лекцію. 18. Вона щаслива, що чула концерт відомого італійського диригента. 19. Він дуже задоволений, що закінчив свою книгу. 20. Наші спортсмени пишаються тим, що виграли кубок. 21. Я тільки хочу, щоб мені дозволили допомогти вам. 22. Я був вдячний, що мені дали кімнату з великим вікном. 23. Він був щасливий, що повернувся додому. 24. Він був щасливий, що знову вдома. 25. Я шкодую, що перервав Вас. 26. Я жалкую, що не застала вас вдома. 27. Джейн була щаслива, що їде від місіс Рід. 28. Рочестер був радий познайомитися з Джейн. 29. Рочестер був радий, що познайомився з Джейн. 30. Він буде радий відвідати цю лекцію. 31. Він був радий відвідати цю лекцію. 32. Він не переносить, коли йому брешуть. 33. Я згадав, що вже зустрічав це слово у якійсь книзі.

**Exercise 13. Combine the two sentences as in the models.**

*Models:* I teach English here. I am glad of it. — I am glad to teach English here.  
We helped him. We are happy about it. — We are happy to have helped him.  
I was examined yesterday. I am glad of it. — I am glad to have been examined yesterday.

A.1. I work at the factory. I am happy about it. 2. I see you. I am glad of it. 3. I study French. I am glad of it. 4. I live in this town. I am happy about it. 5. I know this man. I am happy about it.

B.1. I am going to Paris. I am happy about it. 2. I am spending my holidays in the Crimea. I am happy about it. 3. I am listening to the symphony. I am glad of it. 4. I am reading his letter. I am glad of it. 5. I am playing chess with you. I am glad of it.

C. 1. I spent my holidays in the country. I am happy about it. 2. He played chess with the world champion. He is happy about it. 3. I bathed in the river. I am glad

of it. 4. I learned English at school. I am glad of it. 5. I passed my examination yesterday. I am glad of it. ;

D. 1. I don't understand this rule. I am sorry about it. 2. I am not working there now. I am sorry about it. 3. I have not seen this film. I am sorry about it. 4. She has not been working all these years. She is sorry about it. 5. Peter didn't see her. He is sorry about it.

E. 1. She was not invited to the evening party. She is sorry about it. 2. We are taught English. We are glad of it. 3. I was Waked early this morning. I am glad of it. 4. I was not informed of it. I am sorry about it. 5. I am not allowed to go there. I am sorry about it.

**Exercise 14. Combine the given two sentences into one using the Objective Infinitive Complex.**

Model: *Mary opened the window. I saw it. — I saw Mary open the window.*

1. Peter took my pen. I saw it. 2. He ran to the river. I saw it. 3. The girl smiled. I noticed it. 4. The children shouted in the next room. I heard it. 5. She played the violin. My brother heard it. 6. The nurse tried to open the door. We saw it. 7. They got into a taxi. He saw it 8. Somebody knocked at the door. We heard it.

**Exercise 15. Change the following complex sentences into simple ones using the Objective Infinitive Complex.**

A. 1. We watched the dockers as they unloaded the ship. 2. They watched me as I made my bed. 3. Mother saw him as he climbed over the fence. 4. I watched them as they played ice-hockey. 5. Nobody noticed her as she went away.

B. 1. We expect that he will come back at 7. 2. They expect that their football team will win the game. 3. She expected that her friend would write her a letter. 4. I expect that you will come in time. 5. He expects that his friends will help him.

C. 1. I think that he is a good engineer. 2. I suppose that he is about forty. 3. I believe that they are at home now. 4. I know that she is very modest. 5. They believe that he is honest.

D. 1. My wish is that you should tell me about it. 2. Her parent's wish is that she should enter a music school. 3. Our wish is that you should go to the forest with us. 4. His father's wish is that he should become an engineer. 5. My wish is that you should stay here.

E. 1. I desire that he should see *me* off. 2. I desire that she should go shopping. 3. We desire that he should repair our radio set. 4. I desire that he should stop smoking. 5. I desire that they should return tomorrow.

**Exercise 16. Transform the sentences using the Subjective Infinitive Complex instead of the Objective Infinitive Complex.**

Model: *I saw her read the letter. — She was seen to read the letter.*

1. We heard her sing a folk song. 2. I saw him put his coat on. 3. They heard the clock strike nine. 4. We saw the rider disappear in the distance. 5. We saw the plane take off. 6. They expected him to return in a fortnight. 7. We know her to be a talented actress. 8. Everybody supposed him to be a foreigner. 9. Everybody considered him to be a great man. 10. I expect the telegram to be sent tomorrow.

**Exercise 17. Transform the following complex sentences into simple ones using the Subjective Infinitive Complex.**

A. 1. It is said that they work in the field. 2. It is believed that she knows several foreign languages. 3. It is said that the film is very interesting. 4. It is supposed that he understands Spanish. 5. It is reported that the cosmonauts feel well.

B. 1. It is said that Kate is preparing for her examinations. 2. It is said that they are working in the field. 3. It is reported that the painter is working at a new picture. 4. It is believed that he is writing a historical novel.

C. 1. It is reported that the delegation arrived in Paris on the 10<sup>th</sup> of September. 2. It is reported that the spaceship has reached the moon. 3. It is believed that this house was built in the 18<sup>th</sup> century. 4. It is said that she has been teaching mathematics for thirty years.

D. 1. It is expected that he will arrive on Monday. 2. It is supposed that the book will be published next year. 3. It was expected that the film would be shown in May. 4. It was supposed that the weather would be fine in April. 5. It is expected that he will buy a car.

E. 1. It seems that they live in the same house. 2. It seems that he is composing a new symphony. 3. It seems that he knew it long ago. 4. It seems that she is listening. 5. It proved that you were right. 6. It turned out that the text was very difficult.

**Exercise 18. Transform the sentences according to the models.**

Models: *It is (im)probable that he will come tomorrow. — He is (un) likely to come tomorrow.*

*He will certainly come. — He is sure to come.*

*He will probably come. — He is likely to come.*

A. 1. It is probable that it will rain before evening. 2. It is improbable that she will forget her promise. It is probable that the winter will be very cold this year. 4. It is probable that they will be late. 5. It is improbable that this medicine will help him.

B. 1. They will certainly like this film. 2. The doctor will certainly do his best. "3. He will probably forget the address. 4. She will probably catch cold. 5. He will certainly do his duty. 6. The weather will probably change.

**Exercise 19. Paraphrase the following using the Prepositional Infinitive Complex.**

*Model: The stone was too heavy. I couldn't lift it. - The stone was too heavy for me to lift it.*

1. The text is too difficult. The pupils can't translate it. 2. The car is too expensive. I can't buy it. 3. The story is easy enough. I can read it without a dictionary. 4. The weather was too bad. We couldn't go to the forest. 5. His coat is too long. She can't wear it.

**Test 1 Choose the correct variant:**

1. My younger brother hates to read; he prefers \_\_\_\_\_ to.  
a) to read b) to be reading c) to be read d) to have read
2. I was very upset and I didn't know whom \_\_\_\_\_ to for advice.  
a) to turn b) to be turning c) to have turned d) to have been turned
3. It was nice of you \_\_\_\_\_ me your Grammar book. Without it I would have been lost.  
a) to lend b) to be lending c) to have lent d) to be lent
4. He suddenly awoke from his trance; there was a decision \_\_\_\_\_.  
a) to be made b) to make c) to have made d) to have been made
5. That woman is still sitting. She seems \_\_\_\_\_ over an hour.  
a) to wait b) to be waiting c) to have been waiting d) to have waited
6. There was nothing \_\_\_\_\_, but to wait for the next train which was due at 6.  
a) to do b) to be done c) to be doing d) to have been doing
7. I am glad \_\_\_\_\_ to stay with them in their country-house.  
a) to invite b) to be invited c) to have invited d) to have been invited
8. Can anybody \_\_\_\_\_ me how to use a computer?  
a) show b) be showing c) have shown d) be shown
9. It is not hard \_\_\_\_\_ decisions when you know what your values are.  
a) to be making b) to have made c) to make d) to be made
10. My friend Marion is coming from Chile. I am sorry not \_\_\_\_\_ about it earlier.  
a) to tell b) to be told c) to have been told d) to have told

**Test 2 Choose the correct variant:**

1. She could not but \_\_\_\_\_ to hear such a sad story.  
a) to weep b) weep c) weeping d) to weeping
2. We saw him \_\_\_\_\_ out of the gate.  
a) to go b) go c) to going d) went

3. It was \_\_\_\_\_ for him to finish the work in a day.  
a) false      b) likely      c) hard      d) certain
4. She was unhappy because her father would not \_\_\_\_\_ her go to the party.  
a) let      b) permit      c) allow      d) get
5. She does not know \_\_\_\_\_ to open it with.  
a) how      b) what      c) who      d) whether
6. I hoped \_\_\_\_\_ you by phone, but I couldn't. Why didn't you pick up the receiver?  
a) to reach      b) to have reached      c) to be reaching      d) to have been reaching
7. No words can describe the fascination of the place. It must \_\_\_\_\_.  
a) see      b) be seen      c) have seen      d) have been seen
8. It is not enough to have a good mind; the main thing is \_\_\_\_\_ it.  
a) to be using      b) to use      c) to have used      d) to have been using
9. It would certainly be much better not \_\_\_\_\_ to him at all.  
a) to speak      b) to be speaking      c) to have spoken      d) to have been speaking
10. The only way to get the best of an argument is \_\_\_\_\_ it.  
a) to be avoiding      b) to have avoided      c) to have been avoiding      d) to avoid

### Test 3 Choose the correct variant:

1. Too much drinking will lead him \_\_\_\_\_ himself.  
a) ruining      b) to ruin      c) to have ruined      d) to be ruined
2. I wanted you to help me \_\_\_\_\_ my assignment after school.  
a) finish      b) to be finished      c) to be finishing      d) finished
3. I am sorry \_\_\_\_\_ waiting out of the room for a long time.  
a) to have kept you      b) having kept you      c) keeping you      d) have kept you
4. He was \_\_\_\_\_ to leave the room, when the phone rang.  
a) just      b) soon      c) about      d) immediately
5. I will have \_\_\_\_\_ writing the report by next week.  
a) finished      b) hoped      c) expected      d) promised
6. This apron has no pocket \_\_\_\_\_.  
a) to put things      b) to be things put      c) putting things in      d) to put things in
7. His wealth enables him \_\_\_\_\_ to England.  
a) to have gone      b) to be going      c) to go      d) went
8. She makes it a rule \_\_\_\_\_ early in the morning.  
a) get up      b) to get up      c) to be getting up      d) got up
9. We have \_\_\_\_\_ him to be more careful in everything.  
a) suggested      b) hoped      c) proposed      d) expected
10. \_\_\_\_\_ with, I have no time to have a date with you.  
a) to begin      b) beginning      c) begin      d) to beginning

#### Test 4 Choose the correct variant:

1. She isn't rich enough \_\_\_\_\_ the piano, let alone buy it.  
a) rent    b) renting    c) to rent    d) to be rented
2. She has no alternative but \_\_\_\_\_ him.  
a) to see    b) seeing    c) going to see    d) see
3. It is sometimes difficult \_\_\_\_\_ you have just met.  
a) to make pleasant conversation among people    b) making pleasant conversation to people  
c) making pleasant conversation to for people    d) to make pleasant conversation with people
4. The workers accepted the cut in salary without complaint because they were afraid \_\_\_\_\_ their jobs.  
a) to lose    b) to be lost    c) to have lost    d) lose
5. I would rather study than \_\_\_\_\_ to such a place.  
a) to go    b) go    c) going    d) have gone
6. On my way home I stopped \_\_\_\_\_ some bread at the bakery.  
a) buying    b) to buying    c) to have bought    d) to buy
7. The dog needs \_\_\_\_\_.  
a) to train    b) train    c) to be trained    d) to have trained
8. I never know \_\_\_\_\_ when I go on a trip.  
a) what clothes should be take    b) what clothes to take    c) what clothes will I take  
d) I take what clothes
9. When inflation is rampant, many families find it difficult \_\_\_\_\_ the life style to which they are accustomed.  
a) to maintaining    b) to maintain    c) in maintaining    d) maintain
10. Almost everyone fails \_\_\_\_\_ the driver's test on the 1st try.  
a) passing    b) to have passed    c) to pass    d) in passing

#### Test 5 Choose the correct variant:

1. \_\_\_\_\_, my tennis went daily from bad to worse, and the worse it became, the more I loved it.  
a) To honest be    b) If I be honest    c) To be quite honest    d) Being honest
2. When a molar started to ache, I decided it was time \_\_\_\_\_ a dentist.  
a) see    b) to see    c) to have seen    d) seeing
3. He wasn't \_\_\_\_\_ six miles every day.  
a) strong enough to walk    b) enough strong for walking    c) enough strong to walk  
d) strong enough for walking
4. He asked me if John had the capability \_\_\_\_\_.  
a) to do that    b) to doing    c) doing that    d) do that
5. The tennis champion has been asked \_\_\_\_\_ an exhibition game at the tennis club next Sunday.  
a) play    b) to play    c) to be played    d) to have played

6. Inland canals are used \_\_\_\_\_ farm and factory goods to nearby towns or seaports.  
a) shipping      b) to shipping      c) to ship      d) in shipping
7. I am free \_\_\_\_\_ I did not quite know the sort of creature I had to deal with.  
a) to confess      b) confessing      c) confess      d) in confessing
8. I muttered encouraging words to myself \_\_\_\_\_ up my courage.  
a) to keep      b) being kept      c) keeping      d) to have kept
9. After studying hard to become an accountant, he discovered that it was not what he wanted \_\_\_\_\_.  
a) to do      b) that      c) doing      d) to
10. Pragmatists were hardly the first men \_\_\_\_\_ beliefs control behavior.  
a) insist      b) insisted      c) who insists      d) to insist

## LESSON II

### Text

**Exercise 1. Translate the text using a list of unknown words.**

### **The diet of juvenile Atlantic mackerel (*Scomber scombrus*) feeding in new northern nursery areas along the Norwegian coast**

Vilde R. Bjørdal, Herdis L. Mørk, Kjell Rong Utne, Anders Fernö & Leif Nøttestad

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### **ABSTRACT**

The North-east Atlantic mackerel stock size increased substantially from 2006–2014 coinciding with high recruitment. This resulted in a pronounced northerly geographic expansion of mackerel, followed by an influx of juvenile mackerel into Norwegian waters. The objective of this work was to study the diet and feeding intensity of juvenile mackerel at the new nursing grounds along the Norwegian coast during the summer. Juvenile mackerel were feeding as far north as 70°N. Stomach content was analysed for the first time from co-occurring juvenile and adult mackerel at the same locations. Almost 80% of all juvenile mackerel had prey in their stomachs, and juveniles had similar stomach fullness as adult mackerel in the same areas. The juveniles preyed on a wide variety of prey species and seemed to utilize both passive filter feeding and active particulate feeding. The most abundant prey group was Appendicular, accounting for 31% of the stomach content by weight. Juveniles fed on similar prey species as adults, but their diet niche differed somewhat as adult mackerel fed more on krill. Juvenile mackerel can thus successfully survive and feed on various prey in high latitudes and can potentially be a feeding competitor to other planktivorous fish species in the area.

**KEYWORDS:** Stock expansion, northern feeding areas, diet niche, stomach content, zooplankton, fish larvae

### **Introduction**

The North-east Atlantic (NEA) mackerel (*Scomber scombrus*) is an example of a highly dynamic migratory fish species that has expanded its distributional range in recent years (Nøttestad et al. Citation 2016; Olafsdottir et al. Citation 2019). This expansion has potential implications for other species inhabiting the same niche through increased inter-specific trophic interactions. We have also witnessed new fishing opportunities for fishermen from different countries targeting mackerel due to this large-scale spatial expansion, as well as new challenges for international managers in terms of exploitation level and quota sharing (Spijkers and Boonstra Citation 2017; ICES Citation 2022).

Adult mackerel make extensive long-distance migrations between feeding, overwintering and spawning areas (Nøttestad et al. Citation 1999; Iversen Citation 2002, Citation 2004; Trenkel et al. Citation 2014). During summer the Norwegian Sea and adjacent waters serve as major feeding grounds for adult individuals (Nøttestad et al. Citation 2016; Nøttestad, Diaz et al. Citation 2016), while the traditional nursing grounds have generally been found much further south from the Bay of Biscay, west of Ireland and into the North Sea (Jansen and Gislason Citation 2013; Jansen et al. Citation 2015; ICES Citation 2018), and the Skagerrak area (Iversen Citation 2004; ICES Citation 2018; Jansen et al. Citation 2019). Whereas adult mackerel migrate out of northern areas during winter when food availability is very low, juvenile mackerel do not perform long-distance migrations and are believed to be mostly stationary within relatively limited areas (Jansen et al. Citation 2015). There has been an increase in observations and catches of 1-year-old mackerel in the Norwegian Sea and along the entire Norwegian coast since autumn 2016 (Nøttestad et al. Citation 2018). This is far north of their traditional nursery area, and we have no information about the feeding and diet of juveniles in this new northern habitat. The longer winters with low light levels in northern waters should prolong the period with low food availability compared with the traditional nursing areas in more southern latitudes, but the productive summers and prolonged days for visual feeding in northern areas, including midnight sun (Suthers and Sundby Citation 1996), should on the other hand be beneficial for juvenile mackerel. An increased abundance of juvenile mackerel feeding along the Norwegian coast may however have an impact on the coastal ecosystem, for instance due to increased predation on fish larvae in this region (Skaret et al. Citation 2015). A northward expansion of juvenile NEA-mackerel may also be beneficial for the stock's recruitment as a larger nursery area may be more robust to fluctuating conditions on local scales.

Adult mackerel feed on patchy and seasonally available prey. The diet depends to a large extent on availability (Prokopchuk and Sentyabov Citation 2006; Langøy et al. Citation 2012; Bachiller et al. Citation 2016), and adult mackerel are capable of preying on a wide range of prey species including relatively large prey such as juvenile fish, krill and amphipods (Langøy et al. Citation 2012; Bachiller et al. Citation 2016; Kvaavik et al. Citation 2019, Citation 2021). According to Trenkel et al. (Citation 2014) the feeding behaviour and diet of the juveniles vary with geographic location, time of day, and size of the individual. In the traditional nursery areas juvenile mackerel are potential competitors with other planktivorous pelagic species, as 1-group mackerel are active predators on larger zooplankton such as euphausiids and amphipods, copepods, and smaller crustacean larvae (Olaso et al. Citation 2005). The diet of juvenile mackerel in

Norwegian waters has not previously been studied, and the number of studies addressing the diet of juvenile mackerel are in general scarce.

The main objective of this work was to study the stomach fullness and diet of juvenile mackerel in the new nursing grounds far north along the Norwegian coast during the summer feeding season. We also made comparisons between juvenile and co-occurring adult mackerel. We predicted that juvenile mackerel consume a wide range of prey, but have a somewhat different diet than adult mackerel, due to their lower swimming speed and reduced hunting abilities. As prey availability changes further north (Melle et al. Citation 2004; ICES Citation 2022), we further predicted that the diet would change with increasing latitude. We finally briefly discuss the ecological role of juvenile mackerel within the coastal ecosystem off Norway.

## **Materials and methods**

### **Surveys and biological sampling**

Juvenile (1-year old) and adult (>1-year-old) mackerel were sampled between 60°N and 70°N during the summer 2018. A total of 20 juveniles were sampled at two stations during the Norwegian Spring Spawning Herring (NSSH) post-larvae survey on 17 and 23 June, and a total of 126 co-occurring juveniles and 130 adults were sampled at the 13 stations during the International Ecosystem Summer Survey in the Nordic Seas (IESSNS) from 4–14 July. The sample size of juveniles ranged between 3 and 14 individuals (median 10 individuals). Both juvenile and adult fish were sampled with the Mulpelt 832 pelagic trawl (ICES Citation 2013) with floats at the headline and a vertical opening of 30–35 m towed with a speed of 5 knots for 30 min in the surface. The length and weight of all sampled mackerel were measured on board the vessel. Otoliths were taken out from each individual for age reading and prepared with Entalan, and age determination were conducted by counting the number of winter rings using a microscope (ICES Citation 2018). Two individuals from which no otoliths could be retrieved were 19 cm in length and assumed to be 1-group mackerel, based on known age-length relationship (ICES Citation 2020). Juveniles were defined as individuals aged 1 year and adult mackerel as individuals aged 2 years or older, although 25–50% of 2-year-old mackerel have not yet matured (ICES Citation 2020). To minimize the digestion of stomach content after capture, the stomachs were immediately retrieved from the fish and frozen at sea for later analyses of the stomach content at the lab.

### **Diet analyses**

The mackerel stomachs were opened, and the organisms were identified to species level if possible, or to highest possible taxonomic level otherwise (see examples in Figure 2). In stomachs where only one taxonomic group was found, the unidentifiable digested material was grouped according to this taxonomic

rank. When the stomach content consisted of multiple prey organisms from various taxonomic groups which were difficult to separate, handle or count, the proportion of each prey group in the sample was estimated by subjective evaluation and labelled as a percentage of the total mix. The sorted prey items were dried for 24 h at 70°C, and the dry weight was recorded.

Prey items that could only be identified as crustacean organisms were sorted into the Crustacea category. The taxonomic groups Isopoda and Cladocera and larvae of other crustacean groups (Brachyuran zoea larvae, cirrus larvae of Cirripedia), which were only found as a couple of individuals in few stomachs and accounted for less than 1% of the individual stomach content weight, were grouped together and labelled as 'Other crustaceans'. The prey category 'Other copepods' included digested copepods that could not be identified to species, as well as the three genus' Microcalanus sp., Pseudocalanus sp. and Temora sp.

The prey groups were grouped into the 10 main categories; Amphipoda, Appendicularia, Calanus finmarchicus, Crustacea, Digested, Euphausiacea, Limacina, Other copepods, Other crustaceans and Teleostei. The presence of any prey species belonging to each of the 10 categories were identified for individual mackerel (Stomach occurrence). The proportion of each prey group (Pprey) relative to the total stomach content (in weight) was calculated for each station by summarizing all individuals at a station. The feeding ratio (FR) is an index of stomach fullness and was calculated with the following equation:  $FR = 100m_s / (m_f - m_s)$  where  $m_f$  is the mass (g) of the mackerel and  $m_s$  is the mass (g) of the stomach content. The diet overlaps between juvenile and adult mackerel were calculated with Pianka's index of niche overlap (Pianka Citation 1974). Partly overlapping diets are not necessarily equal to niche overlap, as species using resources independently of each other may still utilize some of the same resources. To test whether the species use the same resources more than what is expected by chance, the overlap index was compared with a null expectation (RA3 algorithm, 1000 repetitions) using the R-package EcoSimR (Gotelli et al. Citation 2015).

### Statistical analyses

A general linear mixed-effects model (GLMM) was used to investigate if FR of juvenile mackerel sampled in July changed with latitude, and a generalized additive mixed-effect model (GAMM) was used to investigate if FR of juvenile mackerel sampled in July changed with distance from shoreland along the Norwegian coast. Preliminary analyses did not indicate any non-linear effects of latitude on FR, and a GAMM was therefore not necessary to explore the relationship between latitude and FR. The GLMM/GAMM had FR as response variable modelled with a negative binomial distribution and the default log-link due to several completely empty stomachs (~20%) and a skewed distribution of

FR values. Latitude and distance from sampling station to nearest shoreline (km) were included as continuous fixed effects and station number as a random effect. The number of splines applied for distance in the GAMM were restricted to 5 to avoid overfitting of the data. Model residuals were assumed to follow a normal distribution with expected value 0 and variance  $\sigma^2$ , and the model performance were assessed for homoscedasticity and normally distributed errors visually using q–q plot and plotting residual variation against the covariates. Furthermore, to test if FR of juvenile mackerel deviated from FR of older mackerel sampled at the same stations, another GLMM was applied. The response variable was FR modelled with a negative binomial distribution and a log-link, ‘juvenile or adult’ as a fixed effect and station number as a random effect. As the negative binomial distribution requires discrete numbers, FR was multiplied with 100 and rounded to nearest discrete number before being applied in the models. Model selection was based on AIC scores and backward elimination of model terms.

## Results

There was geographic variability in juvenile mackerel FR along the Norwegian coast, but the variability was not significantly linearly related to latitude as the final GLMM did not include this term. There was however a significant effect of distance from shoreline on FR, as estimated with a GAM, with the highest stomach fullness for 1-year-old mackerel around 20–50 nmi from the shoreline, and the lowest stomach fullness furthest away from the shoreline. The feeding ratio (FR) for juveniles (min = 0, median = 0.26, 1. Quartile = 0.03, 3. quartile = 0.57, max = 1.68) and adults (min = 0, median = 0.13, 1. Quartile = 0.04, 3. quartile = 0.36, max = 2.61) caught in the same areas did not show a significant difference, as the final GLMM did not have stage (juvenile/adult) included as a fixed effect.

Appendicularia were not consumed in large quantities by juveniles at the southernmost stations but contributed 20% or more to the total stomach content weight at seven of nine stations north of 62°N (IE-5 and onward) sampled in July (Figure 6). Stomachs from the southernmost station (IE-1) was dominated by Cladocerans (included in the group ‘Other crustaceans’). This prey group was not found in the same quantities at any other stations. The station at 69°N (H-2) was the only station out of the total 15 stations where the juveniles had considerable quantities (~25%) of fish larvae in the stomachs.

Juvenile and adult mackerel mainly fed on the same prey organisms as Pianka’s overlap index was 0.73 (see underlying data presented in Figure 6), although they did not have the same feeding niche ( $P = 0.117$ ). Adult mackerel fed more on Euphausiids than juvenile mackerel, with 33% and 4% of the total diet by

weight, respectively. For the remaining prey groups there were only minor differences in total diet by weight between juvenile and adult mackerel.

## **Discussion**

This study investigates for the first time the diet of juvenile mackerel at high latitudes during the summer feeding season along the Norwegian coast, far north of the traditional nursery grounds. This is also the first time stomach content was analysed from co-occurring juvenile and adult mackerel caught at the same locations. A high proportion of juvenile mackerel had prey in their stomachs, and the juveniles had as high relative stomach fullness (feeding ratio) as adult mackerel caught in the same areas. A wide assortment of zooplankton groups that varied with latitude were consumed both by juveniles and adults. This demonstrates that juvenile mackerel far north in the North-east Atlantic can locate and successfully feed on various prey.

This study is based on relatively few samples, but it should be enough to draw the general conclusion that the region along the extensive Norwegian coast serves as an adequate feeding ground for juvenile mackerel. However, the spatial differences found should be interpreted with care.

Visual stomach content analyses, as used in this study, provide a snapshot of the weight composition of the stomach content. Furthermore, if the consumed prey is not too digested, this method can provide information on weight and size/stages of individual prey, compared with using occurrence-based methods. One weakness with the visual stomach content method is that digestion times vary for different prey groups, and that the method only gives a snapshot of the diet which may not be representative for a longer time period. Furthermore, the samples presented in this study were taken within a short time period in late June/July, and the diet composition and mackerel stomach fullness may change rapidly during the summer and autumn. The method has nevertheless been used in several diet studies from the Norwegian Sea (Dalpadado et al. Citation 2000; Prokopchuk and Sentyabov Citation 2006; Langøy et al. Citation 2012; Skaret et al. Citation 2015; Bachiller et al. Citation 2016). We have used the term ‘feeding behaviour’, but it is important to realize that the stomach contents just provide a snapshot of what the fish ate prior to sampling, and not ‘how’ they are feeding. A relatively large copepod such as *C. finmarchicus* may presumably be eaten both by filter feeding and active feeding. To get a better description of the food web in that ecosystem and potential inter- and intraspecific trophic interactions future studies could apply a multi-proxy approach combining stomach content characterization with isotope analyses (Jennings et al. Citation 2002) and genetic analysis.

Plankton sampling related to food availability is available from survey reports, time series from ICES reports and previous publications (Langøy et al. Citation 2012; Nøttestad, Diaz et al. Citation 2016; Ólafsdóttir et al. Citation 2018; ICES Citation 2022). The geographic distribution of zooplankton standing biomass, as measured from WP2 net hauls with 180  $\mu\text{m}$  mesh size from 0–200 m depth, is not correlated to mackerel abundance (Langøy et al. Citation 2012; Olafsdottir et al. Citation 2019). Furthermore, results obtained from WP2 nets most probably underestimate larger zooplankton such as krill and amphipods due to its small sampling diameter. This study has not attempted to directly link mackerel stomach content to prey availability due to the above-mentioned reasons and few sampled stations of zooplankton along the coast in the study presented here.

Since we catch both juvenile and adult mackerel in the same trawl hauls and thus in the same areas along the coast, this may suggest some food competition between juveniles and adults in these areas. There was considerable diet overlap between juvenile and adult mackerel in our study, but our results also suggest an opportunistic feeding behaviour and diet plasticity for both juvenile and adult mackerel, which may reduce the direct prey competition along the Norwegian coast. Juveniles furthest away from the shoreline had significantly lower FR, although the analyses are sensitive to the few stations in the dataset. This finding may be due to food availability as well as competition with adult mackerel. Adult mackerel predominantly feed further offshore in the Norwegian Sea (Prokopchuk and Sentyabov Citation 2006; Langøy et al. Citation 2012; Nøttestad, Diaz et al. Citation 2016), which will limit the direct intraspecific feeding competition along the coast during the summer.

### **Stomach fullness and diet composition**

Juvenile and co-occurring adult mackerel did not have significantly different feeding ratios. The variability in feeding ratio of the juveniles was not related to latitude, and the juveniles seemed to feed as successfully at the northernmost stations as further south in the North Sea.

As predicted, juvenile mackerel along the Norwegian coast feed on similar prey groups as co-occurring adult mackerel. The precocious digestive system could allow the juveniles to feed on prey items that also are preferred by adult mackerel. However, krill were a more important prey for the adults, resulting in different diet niches. The diet of juveniles from our study seems to be different from the diet of juveniles in the traditional nursery areas around the British Isles and within the North Sea basin (Jansen Citation 2016). Juveniles from the traditional nursery areas in the Cantabrian Sea fed primarily on euphasiids, hyperiid amphipods, decapod larvae and copepods (Olaso et al. Citation 2005), while juveniles in the new northern nursery areas mostly feed on Appendicularia, various Crustaceans and copepods. The difference in diet for

juvenile mackerel at the traditional and new northern nursery area is most likely due to spatial differences in prey availability, although temporal differences in sampling may also have impacted the results.

The occurrence of the calanoid copepod species *Calanus finmarchicus* in the stomachs of the juveniles was low when considering it is the most common and preferred prey of adult mackerel in other studies, as well as its role as a key prey potentially regulating juvenile survival in the traditional nursery areas (Jansen Citation 2016). In our study, *C. finmarchicus* only accounted for 1.2% of the total stomach content weight. Some *C. finmarchicus* individuals in early copepodite stages may have been misclassified as *Pseudocalanus*, and if the digested copepods could have been identified to species, it is likely that the total weight and number of *C. finmarchicus* found in the juvenile stomachs would be higher. Juveniles fed on *C. finmarchicus* and one or more individuals were present in ~30% of the stomachs. These findings indicate that there were low concentrations of *C. finmarchicus* where the juveniles were caught, which is supported by the low biomass of this prey species in adult mackerel stomachs from the same areas. The first seasonal bloom of *C. finmarchicus* had likely occurred earlier with the onset of the second seasonal bloom occurring later, resulting in a low abundance of this prey during late June through mid-July (see also Melle et al. Citation 2004). As predicted, the diet of juvenile mackerel changed with increasing latitude. For instance, Appendicularia that contributed to 20% or more to the total stomach content weight at most stations north of 62°N was considerably less frequent at the southernmost stations.

### **Feeding strategy**

Mackerel is predominantly a visual predator potentially feeding during all hours of the day at high northern latitudes during summer with the midnight sun likely being highly beneficial for both juvenile and adult mackerel. As there were many types of prey in the stomachs and the composition varied between stations and across latitudes the results presented in this study indicate that both juveniles and adults seem to be opportunistic when selecting prey and to have a kind of an ‘eat-what-is-present’ behaviour. The sizes of the prey across all stations ranged between 1 mm (*Microcalanus* sp. and *Temora* sp.) and 3–4 cm (krill and fish larvae) (Melle et al. Citation2004). Thus, juveniles along the Norwegian coast seem to switch between passive filtering of smaller plankton through the gill rakes and active feeding on larger prey types in the same way as adults (Bachiller et al. Citation2016; Kvaavik et al. Citation2019, Citation2021).

### **Ecological consequences of the shifts in juvenile distribution**

The ecological effects of the northern expansion of juvenile mackerel are yet unknown. Mackerel is a fast swimming, schooling species that feeds with high intensity (Iversen Citation2004; Nøttestad, Diaz et al. Citation2016), and

increasing numbers of juvenile mackerel along the coast creating an additional predation pressure on the zooplankton community may affect species feeding on plankton through increased interspecific competition (Huse et al. Citation2012). The results presented in this study showed that juvenile mackerel along the Norwegian coast prey on species that are also exploited by adult mackerel. Juvenile mackerel can thus successfully survive and feed on various prey in high latitudes and can potentially be a feeding competitor to other planktivorous fish species in the area, such as Norwegian spring-spawning herring (Langøy et al. Citation2012). Density-dependent growth has been documented for mackerel in the North-east Atlantic and with increasing mackerel abundance after year 2003 the length and weight at age decreased gradually for adult mackerel (Olafsdottir et al. Citation2016). This density-dependent growth suggests that mackerel can deplete the abundance of their main prey at least on a local scale. Overall, there has been a reduction of zooplankton (mainly *C. finmarchicus*) along the Norwegian coast since 2004 (Dupont et al. Citation2017; Toresen et al. Citation2019). Reduced zooplankton abundance in general, and the presence of juvenile mackerel along the Norwegian coast during the summer increase the probability of competition for prey within the mackerel stock along the Norwegian coast. However, adult mackerel predominantly feed further offshore in the Norwegian Sea (Nøttestad et al. Citation2016). Hence, adult mackerel have the possibility to focus their feeding in offshore areas if the competition for prey is too high in coastal waters.

Fish larvae in the stomachs of juvenile mackerel demonstrates that juveniles along the Norwegian coast also target on this type of prey. However, only 6% of the sampled stomachs contained fish larvae, and fish larvae only accounted for 3.3% of the total stomach content weight. The consumed fish larvae are assumed to be herring larvae. Adult mackerel have been found to feed opportunistically on herring larvae (Skaret et al. Citation2015), and this could also be the case for juvenile mackerel, as their distribution during spring and early summer along the Norwegian coast overlaps with the distribution of herring larvae drifting northwards (Dragesund et al. Citation1997). Predation on herring larvae by juvenile mackerel along the Norwegian coast is at present not likely to affect the total herring population but may have local and regional effects (Skaret et al. Citation2015). If an increasing number of adult mackerel make more use of Norwegian waters also as spawning areas, and the nursery areas continue to advance northwards, the impact on local fjord and coastal ecosystems by juvenile mackerel will increase in the future. There is probably no such thing as the ‘optimum’ conditions, rather ‘acceptable’ conditions, but given that both the spawning and feeding of adult mackerel has expanded and shifted to the north, it may be expected that eggs, larvae and juveniles to a larger extent will stay, survive and feed in more northern waters throughout the year. To further understand the ecological role of juvenile mackerel, the use of newly developed

methods such as isotope analyses and DNA metabarcoding can be helpful to determine the effects of egg and/or larvae predation and potential inter- and intraspecific trophic interactions.

**Exercise 2. Translate and study the following words and expressions:**

Post hoc, adult, mackerel, migrations, overwintering and spawning areas, adjacent waters, to serve, nursing grounds, the Bay of Biscay, availability, juvenile mackerel, stationary, an increase, observations, catches, this new northern habitat, to prolong, southern latitudes, northern areas, including, midnight, beneficial, increased predation, larvae, expansion, to fluctuate, local scales, prey, to vary, geographic location, potential competitors, planktivorous pelagic species, active predators, previously, the main objective, the stomach fullness, comparisons, to consume, a wide range, reduced hunting abilities. the coastal ecosystem.

**Exercise 3. Answer the questions:**

1. What resulted in a pronounced northerly geographic expansion of mackerel?
2. Had juveniles similar stomach fullness as adult mackerel in the same areas?
3. Where and when do adult mackerel make extensive long-distance migrations?
4. What should prolong the period with low food availability compared with the traditional nursing areas in more southern latitudes?
5. What mackerel were defined as juveniles and adults?
6. What is the principle for grouping the unidentifiable digested material in stomachs where only one taxonomic was found?
7. What way were the diet overlaps between juvenile and adult mackerel calculated?
8. Why was FR multiplied with 100 and rounded to nearest discrete number before being applied in the models?
9. What does this study investigate?
10. What was consumed both by juveniles and adults?
11. Did juvenile and co-occurring adult mackerel have significantly different feeding ratios?
12. How did the diet of juvenile mackerel change?
13. When and how often does mackerel feed?
14. What is the sizes of its prey?
15. What is the ecological role of juvenile mackerel?

**Exercise 4. Make up as more sentences as you can using the words and expressions from exercise 2.**

**Exercise 5. Make up 25 different type questions for this text.**

### Exercise 6. Write a brief summary of the text.

*Note that:*

- A summary begins with an introductory sentence that states the article's title.
- A summary must contain the main thesis or standpoint of the text, restated in your own words.
- A summary is written in your own words.
- A summary is always shorter than the original text, often about 1/3 as long as the original.

### Exercise 7. Read your summary of the text to your groupmate and ask him to retell it.

### Exercise 8. Make up a plan of this text. Retell the text according to it.

## GRAMMAR

### *The Gerund*

When a verb ends in *-ing*, it may be a present participle or it may be a **gerund**. It is important to understand that they are not the same.

When we use a verb in *-ing* form more like a verb or an adjective, it is usually a present participle:

Anthony is **fishing**.

I have a **boring** teacher.

When we use a verb in *-ing* form more like a noun, it is usually a gerund:

**Fishing** is fun.

Gerunds are sometimes called "verbal nouns". It should also be noted that many grammarians do not like to use the term "gerund" because there is sometimes no clear difference between a gerund and a present participle.

### *Gerund as Subject, Object or Compliment*

Like nouns, gerunds can be the subject, object or complement of a sentence:

**Smoking** costs a lot of money.

I don't like **writing**.

My favourite occupation is **reading**.

But, like verbs, a gerund can also have an object itself. In this case, the whole expression (gerund + object) can be the subject, object or complement of the sentence.

**Smoking cigarettes** costs a lot of money.

I don't like **writing letters**.

My favourite occupation is **reading detective stories**.

Like nouns, we can use gerunds with adjectives (including articles and other determiners):

*pointless* **questioning**

*a* **settling** of debts

*the* **making** of this film

*his* **drinking** of alcohol

When we use a gerund with an article, it does not usually take a direct object:

*a settling of debts* (not ~~a settling debts~~)

*Making this film* was expensive.

*The making of this film was expensive.*

**Tip!**

*Do you see the difference in the following two sentences? In one, "reading" is a gerund (noun). In the other, "reading" is a present participle (verb).*

- 1. My favourite occupation is reading.*
- 2. My favourite niece is reading.*

### **Gerund after Preposition**

Prepositions are always followed by a noun-phrase.

If we want to use a verb after a preposition, it must be a gerund (which functions as a noun). It is impossible to use an infinitive after a preposition. So, for example, we say:

*I will call you after **arriving** at the office.*

*not ~~I will call after to arrive at the office.~~*

*Please have a drink before **leaving**.*

*I am looking forward to **meeting** you.*

*Do you object to **working** late?*

*Tara always dreams about **going** on holiday.*

Notice that you could replace all the above gerunds with "real" nouns:

*I will call you after my arrival at the office.*

*Please have a drink before your departure.*

*I am looking forward to our lunch.*

*Do you object to this job?*

*Tara always dreams about holidays.*

### **Gerund after Certain Verbs**

We sometimes use one verb after another verb. Often the second verb is in the to-infinitive form, for example:

*I want **to eat**.*

But sometimes the second verb must be in gerund form, for example:

*I dislike **eating**.*

This depends on the *first verb*. Here is a list of verbs that are usually followed by a verb in gerund form:

*admit, appreciate, avoid, carry on, consider, defer, delay, deny, detest, dislike, endure, enjoy, escape, excuse, face, feel like, finish, forgive, give up, can't help, imagine, involve, leave off, mention, mind, miss, postpone, practise, put off, report, resent, risk, can't stand, suggest, understand*

*She is considering **having** a holiday.*

*not ~~She is considering to have a holiday.~~*

*Do you feel like **going** out?*

*I can't help **falling** in love with you.*

*I can't stand not **seeing** you.*

**Tip!**

Some verbs can be followed by the gerund form **or** the to-infinitive form without a big change in meaning: *begin, continue, hate, intend, like, love, prefer, propose, start*

I like to play tennis. / I like playing tennis.  
It started to rain. / It started raining.

### Gerund in Passive Sense

We often use a gerund after the verbs *need*, *require* and *want*.

In this case, the gerund has a passive sense.

I have three shirts that *need* **washing**. (need to be washed)  
I sent it back to the shop because it *needed* **fixing**. (needed to be fixed)  
This letter *requires* **signing**. (needs to be signed)  
The contract *will require* **signing** tomorrow. (will need to be signed)  
The house *wants* **repainting**. (needs to be repainted)  
Your hair *has wanted* **cutting** for weeks. (has needed to be cut)

#### Tip!

Note that the expression "something *wants* doing" is used more in British English than in American English.

### Grammar exercises

#### Exercise 1. Complete the sentences with the gerund form of the verbs in brackets:

1. She is good at (dance). 2. He is crazy about (sing). 3. I don't like (play) cards.  
4. They are afraid of (swim) in the sea. 5. You should give up (smoke). 6. Sam  
dreams of (be) a popstar. 7. He is interested in (make) friends. 8. My uncle is  
afraid of (go) by plane. 9. We insist on (cook) the dinner ourselves. he likes  
(paint) 10. I can't bear (listen) to loud music. 11. He enjoys (play) tennis. 12.  
Leila dreams of (set) up her own business. 13. He is interested in (emigrate) to  
Canada. 14. Are you good at (dance)? 15. She is crazy about (read) romantic  
poems. 16. I can't help (laugh) when I watch Mr Bean. 17. I can't imagine (be)  
anywhere else but here.

#### Exercise 2. Put the verb in brackets into either the gerund (-ing) or the infinitive (with 'to').

1. I don't fancy (go) out tonight. 2. She avoided (tell) him about her plans. 3. I  
would like (come) to the party with you. 4. He enjoys (have) a bath in the  
evening. 5. She kept (talk) during the film. 6. I am learning (speak) English. 7.  
Do you mind (give) me a hand? 8. She helped me (carry) my suitcases. 9. I've  
finished (cook) - come and eat! 10. He decided (study) biology. 11. I dislike  
(wait). 12. He asked (come) with us. 13. I promise (help) you tomorrow. 14. We  
discussed (go) to the cinema, but in the end we stayed at home. 15. She agreed  
(bring) the pudding to the dinner. 16. I don't recommend (take) the bus - it takes

forever! 17. We hope (visit) Amsterdam next month. 18. She suggested (go) to the museum. 19. They plan (start) college in the autumn. 20. I don't want (leave) yet.

**Exercise 3. In the sentences below, replace the clauses with the gerund with "of".**

1. I thought *I would come and see you tomorrow*.
2. What do you think *you will do tomorrow*?
3. I don't know now; I thought *I would go to the zoo*, but the weather is so bad that probably I shan't go.
4. I hear there are some English books at our institute book-shelf now. - So you think *that you will buy some*, aren't you?
5. I thought *I would work in the library this evening*, but as you have come. I won't go to the library.

**Exercise 4. In the sentences below, replace the clauses with the gerund with "after".**

1. *After I hesitated some minutes* whether to buy the hat or not, I finally decided that I might find one I liked better in another shop.
2. *When she had graduated from the University*, she left Kiev and went to teach in her home town.
3. *When he proved that his theory was correct*, he started studying ways and means of improving the conditions of work in very deep coalmines.
4. *After she took the child to the kindergarden*, she went to the library to study for her examination.
5. *When he had made a thorough study of subject*, he found that it was a great deal more important than he had thought at first.

**Exercise 5. Replace the infinitives with the gerunds Translate the sentences into Ukrainian.**

1. I like the idea of (to organize) a shooting contest.
2. Are you fond of (to play) tennis?
3. There is no chance of (to get) tickets for this foot-ball match.
4. We had much difficulty in (to translate) that article.
5. I was afraid of (to catch cold).
6. I remember (to tell) them about it.
7. I object to (to discuss) this question at the meeting.
8. Everybody was against (to arrest) that man, but the sheriff.

**Exercise 6. Translate into Ukrainian.**

1. She stopped coming to see us, and I wondered what had happened to her.
2. Can you remember having seen the man before?
3. She was terrified of having to speak to anybody, and even more, of being spoken to.
4. He was on the point of leaving the club, as the porter stopped him.
5. After being corrected by the teacher, the students' papers were returned to them.
6. I wondered at my mother's having allowed the journey.
7. I understand perfectly your wishing to start the work at once.
8. Everybody will discuss the event, there is no

preventing it. 9. At last he broke the silence by inviting everybody to walk into the dining-room. 10. On being told the news she turned pale. 11. Having been carefully read and corrected by the secretary, the text contained no mistakes.

**Exercise 7. Open the brackets using the gerund in its active or passive form.**

1. Why do you avoid (to speak) to me? 2. She tried to avoid (to speak) to? 3. The doctor insisted on (to send) the sick man to hospital. 4. The child insisted on (to send) home at once. 5. Do you mind him (to examine) by a heart specialist? 6. He showed no sign of (to recognize) me? 7. She showed no sign of (to surprise). 8. He had a strange habit of (to interfere) in other people's business. 9. I was angry at (to interrupt) every other moment. 10. He was always ready for (to help) people. 11. He was very glad of (to help) in his difficulty. 12. On (to allow) to leave the room the children immediately ran out into the yard and began (to play). 13. In (to make) this experiment they came across some very interesting phenomena. 14. The results of the experiment must be checked and rechecked before (to publish). 15. The watch requires (to repair). 16. The problem is not worth (to discuss).

**Exercise 8. Translate into English using the Gerund.**

1. Нарешті вони припинили сміятися. 2. Вона заперечувала, що вкрала гроші. 3. Пробачте, що я загубив вашу ручку. 4. Коли вона закінчить писати твір? 5. Я не заперечую (*to contradict*) проти того, щоб залишитися вдома та попрацювати над моїм перекладом. 6. Припиніть тремтіти. Уникайте показувати цим людям, що ви їх боїтесь. 7. Я не можу не (*cannot help*) турбуватися про них: вони перестали дзвонити. 8. Ви не проти того, щоб відчинити вікно? 9. Я дуже люблю читати. 10. Ми отримали задоволення від плавання.

**Exercise 9. Open the brackets using a necessary form of the gerund.**

1. Excuse me for (to *break*) your beautiful vase. 2. You never mentioned (to *be*) to Greece. 3. She was proud of (to *award*) the cup of a champion. 4. I don't remember ever (to *meet*) your sister. 5. I don't remember (to *ask*) this question by anybody. 6. The cat was punished for (to *break*) the cup. 7. The cat was afraid of punishing for (to *break*) the cup. 8. The machine needs (to *clean*). 9. I am quite serious in (to *say*) that I don't want to go abroad. 10. He seemed sorry for (to *be*) inattentive to his child. 11. She confessed to (to *forget*) to send the letter. 12. The old man could not stand (to *tell*) what he should do. 13. Going to the party was no use: he had no talent for (to *dance*). 14. The Bronze Horseman is worth (to *see*). 15. She accused him of (to *steal*) her purse.

**Exercise 10. Replace the highlighted parts of the sentence with a gerundial phrase using the appropriate prepositions where they are necessary.**

1. I am told *that you are very busy*.
2. Thank you *that you did it*.
3. When *young man graduated from Harvard*, he returned to Russia.
4. They gave up the idea *that they would find work*.
5. *After we had passed our examinations*, we had a very entertaining evening.
6. Michael remembered *that he had enjoyed the trip to the Bahamas*.
7. I am thankful *that I have been given a chance to hear this outstanding singer*.
8. Helen insisted *that she should be given that job*.
9. Tom was afraid *that he might be late*.
10. *The fact that you took English lessons some years ago* helps you in your studies now.

**Exercise 11. Read for Errors. Find mistakes in the text and correct them:**

Teaching a new puppy to walk on a leash takes a little bit of practice. The puppy will be playful but not very focused.

Find the right harness is very important. For a puppy, you will want one that attaches to the dog's chest not the dog's neck. Pull the puppy will cause the body of the dog to move forward. If the dog resists or pulls against you, don't force it.

Put a treat in front of the dog is another way to get the dog to walk ahead. Let the dog smell the treat in your hand. Then, walk forward. The dog's nose will follow. Don't let the dog have the treat right away. Let the dog take a few steps before rewarding the dog.

Use a tasty treat to encourage a specific behavior is very effective. With a little bit of practice, a lot of patience, and love, your puppy will become your walking companion.

**Exercise 12. Choose the correct form of the verb in brackets:**

1. Eliza recommended (eating / to eat) in a Dim Sum restaurant while we're in Hong Kong.
2. I demand (talking / to talk) to the manager of the hotel immediately.
3. My grandmother recalled (to see / seeing) a plane for the very first time when she was six.
4. She claims (being / to be) related to George Washington, but I don't believe her.
5. This broken bicycle needs (to fix / fixing) before someone can ride it.
6. I can't understand (driving / to drive) such a big car when gas prices are so high, not to mention what it does to the environment.
7. She refused (to speak / speaking) to me after our fight.
8. The wilderness adventure course lasts ten days and involves (to hike / hiking) more than fifty miles through rugged mountainous terrain.
9. Don't hesitate (asking / to ask) for help if you don't understand the directions.
10. She managed (communicating / to communicate) with them, even though she didn't speak their language.

**Exercise 13. Put the verb in brackets into the gerund or the infinitive:**

1. It appears (be) raining. 2. We intend (go) to the countryside this weekend. 3. I pretended (be) sick so I didn't have to go to work. 4. Can you imagine (live) without TV? 5. They tolerate (smoke) but they prefer people not to. 6. I anticipate (arrive) on Tuesday. 7. A wedding involves (negotiate) with everyone in the family. 8. He denies (steal) the money. 9. He claims (be) a millionaire but I don't believe him. 10. I expect (be) there about seven. 11. Julia reported (see) the boys to the police. 12. It tends (rain) a lot in Scotland. 13. Do you recall (meet) her at the party last week? 14. She mentioned (go) to the cinema, but I don't know what she decided to do in the end. 15. The teenager refused (go) on holiday with his parents. 16. I understand (be) late once or twice, but every day is too much! 17. I would prefer you (come) early if you can. 18. That criminal deserves (get) a long sentence. 19. She completed (paint) her flat. 20. We arranged (meet) at four but at four thirty she still hadn't arrived.

**Exercise 14. Translate the sentences using the gerund:**

1. Ми проти того, щоб відправляти його на конференцію. 2. Ви повинні уникати змін в умовах поставки. 3. Вибачте, що турбую вас. 4. Я пропоную обговорення умов платежу. 5. Перед тим, як підписати контракт, ми повинні вивчити всі його умови. 6. Йому не подобається гаяти час. 7. Вони припинили продавати товар у кредит. 8. Ми відчуваємо великі труднощі з фрахтуванням судна. 9. Ми зацікавлені у проведенні випробувань. 10. Вибачте, що я поставив це запитання.

**Exercise 15. Fill in the gerund with the correct preposition:**

1. She is looking forward ... his aunt in Chicago. (visit) 2. My wife is keen ... pop songs. (sing) 3. His mother was excited ... to Africa. (go) 4. The secretary carried ... the letter. (type) 5. The construction workers worried ... their jobs. (lose) 6. They tried to cope ... in bad weather. (work) 7. The pupil is known ... problems. (cause) 8. My wife apologized ... late. (be) 9. The teacher always keeps ... his timetable. (complain) 10. I insisted ... the dog for a walk myself. (take) 11. The teenager is addicted ... TV. (watch) 12. The actor is famous ... crazy once in a while. (be) 13. The money will be devoted ... the environment. (protect) 14. The au-pair succeeds ... the children busy for some time. (keep) 15. He blamed me ... the CD player. (damage) 16. George Clooney is proud ... in humanitarian projects. (take part) 17. I'm tired ... the same things over and over again. (repeat) 18. She said she was sorry ... the vase. (break) 19. She is scared

... alone at night. (be) 20. I'm very excited ... tomorrow's game. (attend) 21. Jamie is sick ... hamburgers all the time. (eat) 22. She ran away ... behind her. (look) 23. The hikers are worried ... enough water. (not have) 24. We are accustomed ... our own bath. (have) 25. He has a habit ... in the morning. (smoke) 26. The main disadvantage ... is that planes are often delayed. (fly) 27. Her reputation ... difficult games is well-known. (win) 28. My sister has got a talent ... languages. (learn) 29. He took credit ... the goal. (score) 30. She has a lot of experience ... with mentally ill patients. (deal)

**Exercise 16. Transform the sentences using the gerund instead of the infinitive.**

*Model: My father began to work at this plant 20 years ago. — My father began working at this plant 20 years ago.*

1. We continue to study English. 2. The children like to play basket-ball. 3. The sink started to run. 4. His mother intends to spend her holiday at the seaside. 5. They preferred to go there by plane. 6. She tiled to open the window but couldn't. 7. I have just begun to translate the text.

**Exercise 17. Combine the sentences using the gerund.**

*Model: You helped me. I thank you for it. — I thank you for helping me.*

1. You gave me a dictionary. I thank you for it. 2. The woman showed me the way. I thanked her for it. 3. You explained to us this grammar rule. We thank you for it. 4. Ann passed me the salt. I thanked her for it. 5. Nick bought a notebook for Pete. Pete thanked him for it. 6. He repaired my TV set. I thanked him for it.

**Exercise 18. Transform the following sentences using gerundial phrases instead of the subordinate clauses.**

A. *Model: I think Til go to Komarovo next week. — I think of going to Komarovo next week.*

1. I think I'll go to the theatre tomorrow. 2. I think I'll join them. 3. I thought I would buy that coat. 4. Tom thinks he will play hockey on Saturday. 5. She thought she would take a taxi. 6. We think we shall visit him in the hospital.

B. *Model: After he finished school, he worked at a plant. — After finishing school, he worked at a plant.*

1. After they passed their exams, they went to the mountains. 2. Before we moved to this town we lived in Tambov. 3. After she wrote the letter, she went to the post-office. 4. Before you cross the street you must look to the left and then to the right. 5. I turned off the light before I left home. 6. We met him after we walked about two miles.

C. *Models: She insisted that she should go to the library. — She insisted on going to the library.*

*She insisted that she should be sent to the library. - She insisted on being sent to the library.*

1. He insisted that he should show them the way. 2. He insisted that he should be shown the way. 3. They insisted that they should help me. 4. They insisted that they should be helped with their work. 5. I insisted that I should examine them in the afternoon. 6. I insisted that I should be examined first.

**Exercise 19. Paraphrase the following sentences using the gerund.**

A. *Model: I want very much to get a letter from you. — I am looking forward to getting a letter from you.*

1. I want very much to visit that exhibition. 2. She wanted very much to go to the country. 3. He wants very much to be offered this job. 4. We want very much to see this performance. 5. I want very much to be invited to the conference.

B. *Model: It gave me much pleasure to see this performance. — I enjoyed seeing this performance.*

1. It gave me much pleasure to work with him; 2. It gave me much pleasure to read this story. 3. It gave me much pleasure to play tennis. 4. It gives him much pleasure to ride a bicycle. 5. It will give him much pleasure to listen to this lecture.

C. *Model: It is useless to learn rules without examples. — It is no use learning rules without examples.*

1. It is useless to invite her. She won't come. 2. It is useless to grow tomatoes in this region. The summer is too short here: they won't ripen. 3. It is useless to teach her to play the piano. She has no ear for music. 4. It is useless to go shopping now. Most of the shops are closed. 5. It is useless to go to the theatre now. The tickets are sold out.

**Exercise 20. Transform the following Complex sentences into simple ones using the gerund.**

A. *Model: I am sorry that I trouble you. — Excuse me for troubling you.*

1. I am sorry that I ring you up so late. 2. I am sorry that I turned on the radio when you are working. 3. I am sorry that I came so late. 4. I am sorry that I broke your pencil. 5. I am sorry that I went home without waiting for you.

B. *Model: I am sorry that I did not tell you about it. — I am sorry for not telling you about it.*

1. I am sorry that I did not help you yesterday. 2. I am sorry that I didn't wait for you. 3. I am sorry that I did not do my homework. 4. I am sorry that I did not ring you up. 5. I am sorry that I did not answer your letter.

**Exercise 21. Combine the following couples of sentences into one using the gerund.**

A. *Models: I am his pupil. I am proud of it. — I am proud of being his pupil.*

*I was his pupil. I am proud of it. — I am proud of having been his pupil.*

1. He works with professor Collins. He is proud of it.
2. He worked with professor Collins. He is proud of it.
3. He is playing chess with a champion. He is proud of it,
4. He was playing chess with a champion. He is proud of it.
5. She made many mistakes. She is ashamed of it.
6. She makes many mistakes. She is ashamed of it.

C. *Models: I am often Invited there. I am proud of It. — I am proud of being often Invited there.*

*I was invited there. I am proud of it. — I am proud of having been invited there.*

1. He is given an Important task. He is proud of it. 2. He was given an important task. He is proud of it. 3. She is loved by the pupils. She is proud of it. 4. She was loved by her pupils. She is proud of it. 5. The boy is praised by the teacher. He is proud of it. 6. The boy was praised by his teacher. He is proud of it.

C. *Model: We sang together. We enjoyed it. — We enjoyed singing together.*

1. I saw this film. I enjoyed it. 2. She played the piano. She enjoyed it. 3. Tom collects stamps. He enjoys it. 4. The boys played football. They enjoyed it. 5. We bathed in the river. We enjoyed it.

D. *Model: They went home. They did not wait for me. — They went home without waiting for me.*

1. I translate the text. I did not use the dictionary. 2. Mary left home. She did not lock the door. 3. He went to bed. He did not take off his shirt. 4. The boy continued to speak. He did not look at us. 5. The man saved the child. He did not give his name.

E. *Model: I did not take a taxi. I went there by bus. — Instead of taking a taxi, I went there by bus.*

1. We did not go to the seaside. We spent the summer in the country. 2. He was not preparing for his exam. He was playing chess. 3. I did not learn the story by heart. I prepared to retell it. 4. I shall not go to the cinema. I shall watch television. 5. I shan't write her a letter. I'll send her a telegram.

F. *Model: Mother is busy. She is cooking dinner. — Mother is busy cooking dinner.*

1. Tom is busy. He is repairing his bicycle. 2. Jane is busy. She is washing her dress. 3. I was busy. I was preparing my report. 4. The children are busy. They are cleaning the room. 5. The teacher was busy. She was correcting our tests.

G. *Model: This radio set is good. I advise you to buy it. — This radio set is worth buying.*

1. This book is interesting. I advise you to read it. 2. This film is good. I advise you to see it. 3. This house is not very old. I advise you to repair it. 4. This museum has many interesting things. I advise you to visit it. 5. Many scientific works are published in this language. I advise you to learn it.

**Exercise 22. Answer the following questions.**

1. What are you fond of doing? 2. Are you fond of skating? 3. What do you like better: skiing or skating? 4. Do you remember going to school for the first time? What can you say about that day? 5. What films have you seen lately? Which of them is worth seeing? 6. How many English books have you read this year? Which of them are worth reading? 7. What do you dream of becoming? 8. What are you busy doing now? 9. What do we use for cutting bread? 10. What do we use for writing? 11. What do we use scissors for? 12. Is it possible to learn English without working hard? 13. What book did you read last? Did you enjoy it? Why? 14. Did you enjoy travelling by air? Why? 15. Where do you intend spending your holidays?

**Exercise 23. Combine the sentences using gerundial complexes.**

*Model: They lost the game. I am surprised at it. — I am surprised at their having lost the game.*

1. Nick studies very well. His father is proud of it. 2. Kate failed in the examination. We are surprised at it. 3. He will come in time. I am sure of it. 4. She plays the piano very well. I am pleased with it. 5. Our football players won the match. We are proud of it. 6. They are here. I am surprised at it.

**Exercise 24. Paraphrase the sentences using gerundial complexes.**

*Models: I want him to take the floor. — I insist on his taking the floor. I don't want him to be sent there. — I object to his being sent there.*

1. I want Kate to recite this poem. 2. They wanted me to take part in the competition. 3. I don't want Jane to stay here alone. 4. The teacher wanted the pupils to do this exercise. 5. Mother did not want Mary to go to the cinema. 6. I don't want him to be elected chairman. 7. I want her to be sent to the conference.

**Exercise 25. Change the following complex sentences into simple ones using gerundial complexes.**

*Model: When she plays. I enjoy it. — I enjoy her playing.*

1. When you quarrel I dislike it. 2. When you open the window I don't mind it.
3. When they dance I enjoy it. 4. When he gets an excellent mark his parents are pleased with it. 5. If you make noise I dislike it. 6. When you don't know the lesson I am surprised at it. 7. If I pass your examination well I'll be proud of it.

**Exercise 26. Ask your groupmate:**

1. if he enjoys travelling by sea; 2. if he likes playing chess; 3. if he objects to your opening the window; 4. whether he agrees to your using his dictionary; 5. if he intends going to Norilsk this year; 6. whether he is ashamed of making spelling mistakes; 7. if he is sure of passing his examination well; 8. if he dreams of becoming a doctor; 9. if he insists on your playing chess with him; 10. whether he is fond of skating; 11. if his mother is afraid of his catching cold; 12. whether he is afraid of catching cold; 13. whether he is afraid of your catching cold; 14. whether the film he saw last is worth seeing; 15. whether the book he read last is worth reading.

**Test 1 Choose the correct variant:**

1. I would like ... you and some of my other friends for dinner some time.  
a) invite      b) inviting      c) to invite
2. Let's get together tonight. I want to talk about ... a new business.  
a) opening      b) open      c) to open
3. Don't switch off the light. The child is afraid ... in the dark.  
a) of sleeping      b) to sleep      c) sleep
4. George has a Newfoundland dog, Strickland by name, and he is responsible ... it twice a day.  
a) for walking      b) walk      c) to walk
5. As an English proverb says "It's no use ... over spilt milk."  
a) cry      b) to cry      c) crying
6. His son's car crushed into a wall. The terrible tragedy prevented him ... doing what was right or reasonable.  
a) of      b) from      c) in
7. Where do you and your friends plan ... for the next summer vacations?  
a) go      b) going      c) to go
8. Helen seemed genuinely pleased ... seeing me.  
a) with      b) at      c) on
9. My big grey cat Fluffy is good ... mice.  
a) to catch      b) at catching      c) catch
10. I don't like ... these shorts; they are too tight.  
a) to wear      b) wearing      c) wear

## Test 2 Choose the correct variant:

1. I prefer ... jeans in winter and light shorts in summer.  
a) wearing      b) to wear      c) wear
2. Sheila is very upset. She isn't used ... being treated like that.  
a) on      b) to      c) in
3. Don't be afraid ... into the swimming pool; it's quite deep.  
a) of diving      b) to dive      c) dive
4. Lorna intended to help him ... lending him some money.  
a) on      b) while      c) through
5. I enjoy making practical jokes about people, but I hate ... fun of.  
a) being made      b) to make      c) making
6. At the beach I noticed a lot of people ... the same sandals as mine.  
a) to wear      b) wearing      c) wear
7. A: I can't remember if I've taken my tablets today.  
B: I saw you ... two after breakfast.  
a) took      b) take      c) to take
8. I'm sorry ... annoyed with you last night. I was tired.  
a) for getting      b) I get      c) to get
9. I'm sorry ... your friend, Caroline. I shouldn't have said what I said.  
a) for criticizing      b) to criticize      c) I criticize
10. Hannah and I had some good times ... a house.  
a) sharing      b) we shared      c) having shared

## Test 3 Choose the correct variant:

1. Nina can't walk, but that doesn't stop her ... abroad.  
a) travel      b) to travel      c) traveling
2. Do you think Philip would be interested ... volleyball on Saturday? I'm trying to organize a game.  
a) to play      b) of playing      c) in playing
3. I'm sorry ... you this again, but what's your address?  
a) for asking      b) to ask      c) I ask
4. Why did you decide ... for the job at the bakery?  
a) against applying      b) not applying      c) to applying
5. I don't think I'll have the energy ... tomorrow after work.  
a) for to go out      b) to go out      c) to going out
6. When I go camping, it takes me a night or two to get used ... in a tent.  
a) to sleep      b) sleeping      c) to sleeping
7. Hundreds of people have helped us ... money for the children's hospital.  
a) to raise      b) to raising      c) raising
8. If someone's angry with me, I like ... the reason.  
a) to know      b) knowing      c) to have known
9. ... a big lunch, I wasn't hungry until late in the evening.  
a) eating      b) having eaten      c) for eating

10. I regret ... that I will be unable to attend the conference in July. I hope it is a success.

- a) to say                      b) say                      c) saying

#### **Test 4 Choose the correct variant:**

1. Mary: I'm very sorry.

Jame: You don't need .... You haven't done anything wrong.

- a) to apologise              b) apologise              c) apologizing

2. This cupboard is full of very old clothes. Most of them need ... away.

- a) to throw                  b) throw                  c) throwing

3. I'm really fed up with David ... me all the time. He says some horrible things to me.

- a) to criticizing              b) criticizing              c) to criticize

4. Greg won the competition despite ... only 16.

- a) to be                      b) to being                  c) being

5. If someone's angry with me, I like ... the reason.

- a) to know                  b) knowing                  c) to have known

6. I'm sorry. I didn't understand what you said. Would you mind ... it again to me?

- a) to explain                  b) explaining                  c) explain

7. George: Would you like to be a film star?

Finn: I'd rather ... a pop star.

- a) to be                      b) be                          c) being

8. Jack: Shall we keep these magazines?

Helen: I'd prefer ... them away. They're very old.

- a) to throw                  b) throw                  c) throwing

9. I regret ... that I will be unable to attend the conference in July. I hope it is a success.

- a) to say                      b) say                          c) saying

10. Owen has offered ... me his computer for a few weeks.

- a) to lend                      b) lend                          c) lending

#### **Test 5 Choose the correct variant:**

1. In last week's match, I felt someone suddenly ... me in the face, but I don't remember anything after that.

- a) hit                          b) to hit                          c) hitting

2. Selena: When did Michelle leave?

Smith: I don't know. I didn't see her ... .

- a) go                          b) going                          c) to go

3. John carried on ... even though no one was listening.

- a) to talk                      b) talking                      c) having talked

4. Nina can't walk, but that doesn't stop her ... abroad.  
a) travel            b) to travel            c) traveling
5. Could you give me the list of people coming to the conference ... all their names?  
a) to have            b) for to have            c) so that I have
6. We couldn't find anywhere ... in the town centre.  
a) to stay            b) for staying            c) to staying
7. Please remind me ... Sam about this place. He would love it here.  
a) tell            b) to tell            c) telling
8. Do you want ... you from the station this evening?  
a) that we collect    b) we to collect            c) us to collect
9. I'm going to London tomorrow, but I haven't decided yet ... or go by train.  
a) whether I drive            b) whether to drive            c) whether drive
10. I was interested ... that the principal of my college is going to retire next year.  
a) to read            b) in reading            c) for reading

## LESSON III

### Text A

**Exercise 1. Translate the text using a list of unknown words.**

### **Effects of microplastics on sessile invertebrates in the eastern coast of Thailand: An approach to coastal zone conservation**

Gajahin Gamage Nadeeka Thusharia, b, Jayan Duminda Mahesh Senevirathnaa, Amararatne Yakupitiyageb,  
Suchana Chavanichc, \*

a Department of Animal Science, Faculty of Animal Science and Export Agriculture, Uva Wellassa University,  
Passara Road, Badulla, Sri Lanka

b Aquaculture and Aquatic Resources Management, School of Environment, Resources and Development, Asian  
Institute of Technology, P.O. Box 4, Klongluang,

### **Abstract**

This study assessed the microplastic contamination of 3 most abundant sessile and intertidal invertebrates (Rock Oyster: *Saccostrea forskalii*, Striped Barnacle: *Balanus amphitrite*, Periwinkle: *Littoraria* sp.) in 3 beaches of the eastern coasts of Thailand. The results showed a significant accumulation of microplastics in the invertebrates at rates of 0.2–0.6 counts/g indicating higher pollution levels along the coastline. Filter feeding organisms showed comparatively higher accumulation rates of microplastics. Thus, contaminated bivalves pose potential health risks for seafood consumers. The plastic pollutant prevalence in sessile and intertidal communities was corresponded with pollution characteristics of contaminated beach habitats where they live. Thus, bivalves, gastropods and barnacles can be used as indicators for contamination of microplastics in the areas. This study also demonstrated the need for controlling plastic pollution in Thai coastal areas.

### **1 Introduction**

The coastal zone is defined as the geomorphological region on either side of the seashore where the biotic and abiotic components of the marine and terrestrial environments interact to form complex ecological and economic resources systems, in which the human population, both resident and tourist, performs their social, recreational and commercial activities (Protocol on Integrated Coastal Zone Management in the Mediterranean, 2012). The zone is an ideal place for human activities such as for housing developments, commercial industries and human recreation (Nordstrom, 2000) and consequently is affected by various perturbations such as pollutions (Brown and McLachlan, 2002).

Among the existing pollutants, plastic is a global concern recently because of its negative effects on the coastal and marine environment. The plastic production has doubled worldwide over the past 15 years due to its durability,

low cost, attractive appearance, and light weight (Thompson et al., 2004; Plastics Europe, 2010; Jambeck et al., 2015). As a result, approximately 89% of coastal and marine debris is plastic, and > 45,000 pieces of plastic per square mile have been estimated worldwide annually (Central database system and data standard for marine and coastal resources, 2013). The presence of plastic debris in the coastal environment is caused by the tourism, agriculture, aquaculture, fisheries and industrial sectors (Nagelkerken et al., 2001; Fujieda and Sasaki, 2005; Oigman-Pszczol and Creed, 2007).

When plastic reaches the ocean, a fraction of the dense plastic debris is submerged into the deep sea floor, whereas the other fraction remains as floating debris with close proximity to the sea surface and gradually accumulates along the coastal belt (Webb et al., 2013; Thevenon et al., 2014). When mega- and macro- sizes of plastics debris are exposed to atmospheric chemical reactions, ultraviolet rays, sea water, and other physical forces, such as wave actions, these debris gradually break down into micro-sized plastic particles (< 5 mm) (Webb et al., 2013; Barnes et al., 2009; Arthur et al., 2009). Microplastic particles have a similar size range with that of food and other suspended type particles (Wright et al., 2013). Consequently, different invertebrates in the coastal ecosystems are more likely to ingest these micro-sized plastic particles. Sessile organisms or species with low motility in their native habitats are directly affected by these environmental changes (Oehlmann et al., 2009; Thompson et al., 2004; Ward and Shumway, 2004). The impact of microplastic ingestion on different invertebrate groups with diverse feeding mechanisms has been studied in different parts of the world (Thompson et al., 2004; Leslie et al., 2013; De Witte et al., 2014). These previous studies also showed that the eco-toxicological conditions of particular species were related to the environmental stress levels in their habitats (Nayar et al., 2004). However, no study was done in Thailand.

From previous studies, significant quantity of plastic accumulates into the oceanic environment and coastal ecosystems are mainly from Asian countries including Thailand which have comparatively high economic growth rates (Jambeck et al., 2015; Ocean Conservancy Report, 2015). Plastic has also been identified as one of key component in Municipal Solid Waste (MSW) composition of Thailand (Chiemchaisri et al., 2006; Kaosol, 2009). Thus, land based plastic can be the main source of plastic pollution in coastal waters (Jambeck et al., 2015; Ocean Conservancy Report, 2015).

Chonburi Province, located in the upper Gulf of Thailand, is one of the most rapid industrialized development areas and urban settlement during the past two decades (Thongra-ar and Parkpian, 2002). Intense tourism and large-scale commercial fishery activities cause plastic contamination along this coastline (Thushari et al., 2017). Consequently, these rapid expansions of man-made activities pose a potential risk to the survival, growth, and ecological relationship of floral and faunal communities and humans. Sessile and intertidal invertebrates, including barnacle, bivalve and gastropod populations, are

potentially affected by coastal pollutants, such as plastic debris in this coastline (Thushari et al., 2017). However, several intertidal bivalves have high commercial values because they are popular seafood sources among local residents and tourists in this area. Thus, the eco-toxicity investigation of invertebrates can be useful for identifying whether these seafood sources are within the range of accepted health standards. Currently detailed ecotoxicological indicator data are not available for predicting the effects of plastic pollution along this coastline in Chonburi province, Thailand. This study focused on the assessment of accumulation rate of microplastic debris in sessile and intertidal invertebrates: rock oyster (*Saccostrea forskalii*), striped barnacle (*Balanus amphitrite*), and periwinkle (*Littoraria* sp.) that represent the bivalve, crustacean and gastropod taxonomic groups respectively.

## **2 Materials and methods**

### **2.1 Study sites**

Three study sites (Angsila, Bangsaen, Samaesarn) were selected at Chonburi Province, the upper Gulf of Thailand (Fig. 1) to represent three different coasts with different anthropogenic activities. Bangsaen is a local tourist destination. Angsila is a coastal fishery village with commercial fishing and shellfish culture practices. Angsila is also a popular destination for fresh seafood. Samaesarn beach is in the Royal Thai Naval base. However, the area is currently affected by nearby fishing village and tourism activities.

### **2.2 Analysis of accumulation rates of microplastic contaminants in natural inhabitants**

#### **2.2.1 Sampling of invertebrates**

Three invertebrate species (namely, the striped barnacles *Balanus amphitrite*, the periwinkle *Littoraria* sp., and the rock oyster *Saccostrea forskalii*) were selected for microplastic level screening. These organisms are the dominant natural inhabitants in the study sites. The selected species were randomly collected from the intertidal zone on the surveyed beaches from March to May 2015 during low tides. Sessile organisms that are attached to natural hard substrates (rocks) and synthetic debris items (polystyrene, nylon, and hard plastic substrates) were considered during the sampling of invertebrates and pooled prior to the analysis. A total of 50 specimens of periwinkles (> 0.8 cm shell length), 50 specimens of striped barnacles (> 1 cm shell length), and 15 specimens of rock oysters (4–6 cm shell length) were collected in each site, and separately placed inside the specimen glass bottles to prevent cross-contamination. In the laboratory, sampled organisms were thoroughly rinsed by filtered distilled water. All encrusted organisms, impurities, and sediments attached to the invertebrate shells were removed. Microplastic analysis was performed without subjecting to the depuration process because the value prior to depuration reflects the original quantity of microplastics in the specimens,

which are linked to the current environmental condition during samplings (Cauwenberghe and Janssen, 2014).

### **2.2.2 Laboratory tests to analyze microplastic levels of biota**

After thoroughly rinsing the samples, each specimen sample was dissected. The samples, including the digestive tracts, were kept in separate, rinsed glass bottles to prevent contamination. The prepared samples were frozen, until further used. In addition, each prepared sample was weighed for a final calculation prior to the analysis. Samples were digested following the protocol of Claessens et al. (2013). Samples were soaked overnight in 20 mL of 69% concentrated nitric acid (22.5 M; 5 mL acid was used for 1 g wet sample) at room temperature. Then samples were boiled for 2 h (at 100 °C). After that, the solution was diluted (1:10 v/v) in 200 mL of warm (nearly 80 °C) filtered and de-ionized water (FDW). After dilution, the solution was subsequently vacuum filtered by a preweighed 5 µm cellulose nitrate membrane (Whatman AE98). Blank extractions were performed without the sample to minimize errors caused by including contaminants in the chemical reagents. At least three replicates were used from each sample to obtain accurate results. After filtration, membrane filter was observed using a stereo microscope (Olympus) to detect microplastic particles under 4×, 10× and 40× power objective lenses.

Raman spectroscopy was used to detect micro-particle diversity in the analyzed samples. Raman spectra were obtained with a NT-MDT Raman spectrometer (model: NTEGRASpectra module) attached to an Olympus 1×71 microscope and a thermo-electrical cooled chargecoupled device (CCD) detector. The grating value of the instrument was 150/500, and the spectrometer was controlled by the Nova 1.1.01837 software. Raman spectra were obtained for different expected spots of the same sample at a laser wavelength of 632.8 nm, with an average of 10.00 s scans over Raman wave numbers of 0–5000  $\text{cm}^{-1}$ . The instrument was operated at 8.212  $\text{cm}^{-1}$  of the resolution spectrum. Reference spectra of the major plastic type were selected by library searching. All spots of the sample Raman spectra between intensity and Raman shift were prepared with the Origin 6.1 software. The unknown Raman spectra of suspected points in each sample were consecutively compared with the reference spectra of different plastic types (Polyethylene, PET; High-Density Polyethylene, HDPE; Low-Density Polyethylene, LDPE; Polypropylene, PP; Polystyrene, PS; Polyamide Nylon, PA; Polyvinyl Chloride, PVC) in the spectral library to determine the plastic categories in the samples.

### **2.2.3 Statistical analysis**

The SPSS statistical software was used to analyze the data. The results on plastic accumulation showed normal distributions by the normality test. Therefore, one-way analysis of variance was used to compare the level of contaminations of the different invertebrate groups in the surveyed sites. Given a significant

difference, Tukey HSD pair-wise post-hoc mean comparison tests were used to compare the variability of microplastic accumulation rates in organisms within the sites.

### 3 Results

Most specimens were contaminated with microplastic particles at rates of 0.2–0.6 particles/g. However, the periwinkle samples collected from Bangsaen were not contaminated (Table 1). Based on the results, the microplastic accumulation rates of the invertebrate samples varied according to the spatial locations. Angsila site had the highest recorded concentrations of microplastic particles for all samples (barnacles,  $0.43 \pm 0.33$ ; oysters,  $0.57 \pm 0.22$ ; periwinkles,  $0.23 \pm 0.02$ ) (Table 1).

Statistical analysis revealed significant differences on the densities of detected plastic contaminants between animal groups (barnacles, oysters, and periwinkles) even in the same geographical location ( $p < 0.05$ ). The highest mean microplastic number was observed in the rock oyster samples (0.57 particles/g), whereas the lowest mean microplastic debris was detected in periwinkles (0.17 particles/g) (Table 1). Based on microscopic detection and scanning electron microscopy, all accumulated micro-particles in the samples are rod shaped and fragmented synthetic fibers, with diverse colors, including red, brown, blue, white and transparent (Fig. 2). Spherical or particle shaped plastics were not observed. The qualitative characterizations of micro-debris were further analyzed and confirmed by Raman spectroscopy. Specific peaks in the Raman spectra of each suspected spots in the samples were matched with the specific reference library spectra. Therefore, the detected micro-debris fragments in biotic samples were identified as the microplastic particles (Fig. 3–5). According to the Raman spectroscopy results, the detected microplastic particles were composed of PS, PET, and PA in field collected (Fig. 3–5).

Majority types of the microplastics detected in the samples were PA and PET particles, whereas PS particles were detected in lower amounts (Fig. 6). Barnacle samples collected from the Samaesarn site had the highest accumulation rate of PA (85.71%), whereas the barnacles in Angsila had high level of PET particles (38.46%) compared to the ones from other two sites (Fig. 6). The results also revealed that high PA levels occurred in the oyster samples from Angsila and Samaesarn (70.59% and 61.54% respectively), while the oysters at Bangsaen had high level of PET particles (63.54%) (Fig. 6). No microplastic was detected in the periwinkles from Bangsaen.

### 4 Discussion

These results revealed the microplastic ingestion by marine invertebrate organisms in the intertidal zone, the upper Gulf of Thailand. Studies conducted by Cauwenberghe et al. (2015), Cauwenberghe and Janssen (2014), and Leslie et al. (2013) also confirmed that different invertebrates in polluted coastal

ecosystems are more likely to ingest these micro-sized particles because of their smaller dimensions, and the microplastic accumulation rates of marine invertebrates varied depending on locations. Plastic densities in marine and coastal ecosystem can be influenced by various factors such as the recreational value, proximity to residential areas, commercial fishing, heavy rainfall with flooding, and surface current pattern (Desforges et al., 2014). Based on the results of the current study, the pollution levels of intertidal habitats, distances between habitat locations and anthropogenically-affected areas in the beaches were the main factors affecting the densities of microplastics ingested by marine invertebrates. The contamination levels of invertebrate samples in this study sites reflected the health status of the coastal environment. Thus, field-collected invertebrate species such as striped barnacle, periwinkle, and rock oyster from this study can be used as bio-indicators of plastic pollution in coastal and marine environments. At Angsila, it seems that pollution control mechanisms are not seriously implemented, thus the area and marine invertebrates have been affected by commercial fishing and shellfish culture practices led to the plastic pollution. Consequently, all samples collected from Angsila showed higher accumulation rates of microplastic debris. Other study also showed that sessile organisms were contaminated by colorful synthetic microplastic fibers, which may enter by activities of the fishing harbors such as damaged fishing gears disposal, and net repairing, thereby reflecting the contamination potential with the degree of coastal pollution levels (De Witte et al., 2014).

From this study, filter feeders were highly susceptible to microplastic accumulation indicating highest micro debris density compared to other kinds of filter feeders (Tables 1 and 2). The susceptibility rates to microplastics of different organisms depend on their feeding strategy (Table 2; Leslie et al., 2013; Thevenon et al., 2014). Oysters and barnacles use the filter feeding mechanism by protruding their cirri outwards to create water currents (Riisgard, 2015). During their feeding, water with suspended particles, food materials, and plastic debris enters into the body cavity without selection, and accumulates in their bodies (Osborn, 2013; Food and Agricultural Organization of United Nations, FAO, 2015; Riisgard, 2015). The periwinkle is a substrate scraper with grazing behavior. This species exhibits a selective feeding pattern with diverse feeding items such as algae and diatoms (Grando and Caballero, 2001). Periwinkles are vulnerable to the plastic accumulation when fed with contaminated food (Leslie et al., 2013; Goldstein and Goodwin, 2013).

The current study detected three types of plastic fragments by using the Raman spectroscopy, suggesting that it is an effective and reliable method for confirming the plastic fragments (Cauwenberghe et al., 2013). Based on the present and past results (Thushari et al., 2017), disposal of the damaged or unusable fishing nets, twisted nylon ropes into the off-shore area, and shoreline fishing-related activities in the harbor (net mending, and fishing gear parts removal) increased the accumulation rate of PA nylon particles in the Angsila

and Samaesarn sites. In addition, the greater accumulation level of PET and PS particles in the field-collected samples from Bangsaen and Samaesarn was caused by high tourism activities (in this study; Thushari et al., 2017). Most beach goers and seafood vendors tend to remove food wrapping and packaging items on the beach, thus, micro-PET and micro-PS particles tend to be deposited on beach surfaces rapidly, and also these non-point floating anthropogenic debris can be carried and deposited along the shorelines during high tide (Thushari et al., 2017). Other study also found that polyamide nylon, polyethylene, and polyvinyl chloride are major types of plastic with high deposition rates in the coastal ecosystems (Thevenon et al., 2014).

Plastics usually persist in the relative environment over a longer period of time without decomposing (food packaging: 200 years, disposable plastic cups: 450 years, straws: 20–1000 years) with harmful impacts on coastal communities (Ocean Defender Adventures, 2015). Mato et al. (2001) reported that for persistent-type organic pollutants like poly-chlorinated biphenyl, the absorption rate of these microparticle plastics was significantly higher compared with the surrounding salt water. The accumulation of these toxic compounds in the microparticle plastics lead to shift those persistent chemicals into body tissues of organisms with different chronic health risks, such as carcinogenic effects and hormonal imbalance (Browne et al., 2013; Thevenon et al., 2014). Gradually, this bioaccumulation has a negative impact on coastal biodiversity and ecosystem services. Marine organisms with accumulated microplastic types and toxic compounds are more likely to transfer these poisonous compounds into other organisms at higher trophic levels by interspecific feeding interaction (Cole et al., 2013). Oysters are popular seafood in the eastern part of Thailand. Thus, the potential risk for health can be higher when contaminated seafood is consumed (Hussain et al., 2001). However, detailed investigation is required to understand the detrimental impact of toxic microplastic uptake by marine organisms via the trophic interaction in coastal and marine ecosystems.

## **5 Conclusions and recommendations**

The accumulation of toxic contaminants in sessile and intertidal organisms significantly reflected the higher anthropogenic stress on the eastern coast of Thailand. Microplastic accumulation in intertidal invertebrate communities was mainly affected by plastic pollution along the beaches. The types of ingested microplastics and their accumulation rate were correlated with the degrees of pollution in the coastal habitats as well as the feeding patterns of invertebrates, and can reflect the health status and risks. Health risks are possible when people consume these contaminated marine organisms, particularly shellfish. From this study, effective management programs for the plastic pollution are urgently needed in the study sites and adjacent areas. In addition, it is suggested that pollutant accumulation in marine organisms and cultured shellfish in other

provinces nearby should be further investigated to ensure the safety conditions of environmental and human health.

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### **Exercise 2. Translate and study the following words and expressions:**

Post hoc, to assess, the microplastic contamination, the most abundant sessile, intertidal invertebrates, accumulation, bivalves, to pose, potential health risks, seafood consumers, gastropods, barnacles, abiotic components, the marine and terrestrial environments interact, to form complex ecological and economic resources systems, housing developments, commercial industries, human recreation, various perturbations, durability, weight, coastal and marine debris, to estimate, annually, a fraction, to submerge, to remain, floating, wave actions, particles, to ingest, low motility, habitats, environmental changes, diverse feeding mechanisms, the eco-toxicological conditions, the environmental stress levels, growth rates, floral and faunal communities, to represent, crustacean and gastropod taxonomic groups, biota, the samples, to dissect to prevent contamination, to boil, the solution, errors.

### **Exercise 3. Answer the questions:**

1. What is the coastal zone?
2. Why is plastic considered as one of the main pollutants in the world?
3. What occurs when plastic reaches the ocean?
4. Why do several intertidal bivalves have high commercial values?
5. When and where were the selected species collected?
6. Why was microplastic analysis performed without subjecting to the depuration process?
7. What was used from each sample to obtain accurate result?
8. Did the microplastic accumulation rates of marine invertebrates vary depending on locations?
9. What do the susceptibility rates to microplastics of different organisms depend on?
10. How long do plastics usually persist in the relative environment?

11. What way do marine organisms with accumulated microplastic types and toxic compounds transfer these poisonous compounds into other organisms at higher trophic levels?
12. What is the reason of the greater accumulation level of PET and PS particles in the field-collected samples from Bangsaen and Samaesarn?
13. What reflected the higher anthropogenic stress on the eastern coast of Thailand?
14. What were the types of ingested microplastics and their accumulation rate correlated with?
15. When are health risks for people possible?

**Exercise 4. Make up as more sentences as you can using the words and expressions from exercise 2.**

**Exercise 5. Make up 25 different type questions for this text.**

**Exercise 6. Write a brief summary of the text.**

*Note that:*

- A summary begins with an introductory sentence that states the article's title.
- A summary must contain the main thesis or standpoint of the text, restated in your own words.
- A summary is written in your own words.
- A summary is always shorter than the original text, often about 1/3 as long as the original.

**Exercise 7. Read your summary of the text to your groupmate and ask him to retell it.**

**Exercise 8. Make up a plan of this text. Retell the text according to it.**

## **GRAMMAR**

### **Participles – Present, Past and Perfect**

A participle is an impersonal form of a verb that can be used as an adjective or to form compound tenses.

There are two types of participles in English; present participles (*boring, doing, eating ...*) and past participles (*bored, done, eaten ...*).

These can be combined to form perfect participles (*having done, having said ...*), which are used in participial phrases.

Today, Ella is running her first ever marathon.

She's been training for months and has done many practise races in preparation for the real thing.

Feeling nervous, Ella approaches the start line with the other excited runners.

The starting pistol is fired and the race begins.

The present participle forms by adding -ing to the infinitive of the verb.

do → doing

talk → talking

**Spelling rules:**

1. remove the final -e before adding -ing (note: -ee stays the same)

use → using

but: agree → agreeing

2. double the final consonant when it follows a short, stressed vowel (exceptions: -w, -x, -y)

sit → sitting

but: fix → fixing

3. an -ie at the end of the infinitive becomes -y

tie → tying

lie → lying

British English doubles the final -l of verbs like *cancel*, *travel*, etc.

travel → travelling

**The past participle** is also known as the third form of the verb (e.g. *do–did–done*). For regular verbs, we add -ed to the infinitive. This means that for regular verbs, the past participle is identical to the simple past form.

want – wanted – wanted

walk – walked – walked

Irregular verbs have their own form, which must be learned by heart. Sometimes the past participle is the same as the simple past form, sometimes it is different.

speak – spoke – spoken

sell – sold – sold

**English participles have two main uses:**

**1. Forming compound tenses**

- use the present participle (-ing form) in progressive tenses  
Today, Ella *is running* her first ever marathon. (*present progressive*)  
She *was training* last week. (*past progressive*)
- use the past participle (3rd form of the verb) in perfect tenses  
She *has done* many practice races. (*present perfect simple*)  
In five hours she *will have finished* the race. (*future perfect simple*)
- use the past participle of *be* (= *been*) and the present participle of the main verb in perfect progressive tenses  
She *has been training* for months. (*present perfect progressive*)

As you can see from the examples above, despite what their names may suggest, the *present* and *past* participles are not just restricted to the *present* and *past* tenses!

## 2. Adjectives

The second use for the participles is as adjectives. They can come before the noun they modify or after linking verbs like *be*.

The *atmosphere* is amazing.

Ella's predicted *time* is around 5 hours.

Often, we have to choose between participle adjective pairs (e.g. *bored* vs. *boring*; *confused* vs. *confusing* ...).

The difference is as follows:

- use the past participle to describe a feeling or effect  
Ella feels inspired when she sees the other runners. = she experiences inspiration
- use the present participle to describe the person/thing that causes said feeling or effect  
The other runners are inspiring. = the other athletes inspire Ella

### The present participle as an adverb

In some cases, the present participle appears as an adverb. These modify verbs, adjectives and other adverbs.

Ella *ran* smiling across the finish line.

The weather was boiling *hot* that day.

### Participial phrases (clauses)

Participles are used to create participial phrases (also known as *participial clauses* or *participle phrases*). These are adjective phrases that begin with a present, past or perfect participle.

Participial phrases are used in written language. They allow us to give more information about a noun without having to use a full clause.

Feeling nervous, Ella approaches the start line. = Ella is feeling nervous as she approaches the start line.

The participial phrase must refer to the same noun as the main clause.

Exhausted like never before, Ella crossed the finish line with a big smile on her face. = Ella was exhausted like never before as she crossed the finish line ...

Participial phrases are often used to shorten relative clauses.

It's inspiring to see so many runners focusing on the same goal. = It's inspiring to see so many runners *who are focusing on the same goal*.

### The perfect participle

The perfect participle is formed with the present participle of *have* and the past participle of the main verb (e.g. *having said*, *having done*, *having left* ...).

Unlike the standard present and past participles, the perfect participle is only used in participial phrases and is mostly limited to written English.

The perfect participle emphasises that an action was already completed when another action took place.

*Ella had trained for months and she felt ready for the marathon. → Having trained for months, Ella felt ready for the marathon.*

### **Grammar exercises**

**Exercise 1. Rewrite the sentences replacing the underlined part with the Present Participle.**

*Example: She was talking to her friend and forgot everything around her.  
Talking to her friend she forgot everything around her.*

1. Since we watch the news every day we know what's going on in the world. 2. They are vegetarians and don't eat meat. 3. The dog wagged its tail and bit the postman. 4. While she was tidying up her room she found some old photos. 5. He was a good boy and helped his mother in the kitchen. 6. As they didn't have enough money they spent their holidays at home last year. 7. The man was sitting in the cafe. He was reading a paper. 8. Since I didn't feel well I didn't go to the cinema. 9. She walked home and met an old friend.

**Exercise 4. Make up the sentences and make clear that the people don't / didn't/ won't do it themselves.**

*Example: Yesterday, (I / cut / my hair).  
Yesterday, I had my hair cut.*

1. Every Friday, (Joe / wash / his car). 2. Tomorrow, (she / repair / her shower). 3. Each Saturday, (we / deliver / a pizza) to our home. 4. Last year, (Bob / clean / his house) by a charwoman. 5. As Phil had a broken arm, (he / type / his texts) by his secretary. 6. (I / pick up / the goods) tomorrow in the afternoon. 7. (we / redecorate / our walls) last summer. 8. Whenever Clara is staying at this hotel, (she / carry / her bags) into her room. 9. (we / organize / our last party) by professionals.

**Exercise 3. Rewrite the sentences replacing the underlined part with perfect participle.**

*Example: We switched off the lights before we went to bed.  
Having switched off the lights we went to bed.*

1. The boy asked his mother's permission and then went out to play ... the boy went out to play.

2. As he had drunk too much, he didn't drive home himself. ... he didn't drive home himself.
3. We have written two tests today, so we are very exhausted. ... we are very exhausted.
4. She filled the washing machine and switched it on. ... she switched it on.
5. She had been to the disco the night before and overslept in the morning ... she overslept in the morning.
6. We had worked in the garden all day and were sunburned in the evening. ... we were sunburned in the evening.
7. She had not slept for two days and therefore wasn't able to concentrate ... she wasn't able to concentrate.
8. Since I had not seen him for ages, I didn't recognize him ... I didn't recognize him.
9. I had not ridden a horse for a long time and found it very difficult to keep in the saddle. ... I found it very difficult to keep in the saddle.

**Exercise 4. Fill in the Perfect Participle. Decide whether using active or passive voice:**

1. (stop) ... the car, the police officer wanted to see the documents.
2. (write) ... the test, we felt relieved.
3. (work) ... 11 day, we were quite exhausted in the evening.
4. (send) ... to counter 24, I had to return to counter 3.
5. (confess) ..., he was accused of even more criminal offences.
6. (arrive) ... at the station, we called a taxi.
7. (type) ... by the secretary, the letter was signed by the boss.
8. (interrupt) ... several times, he was rather annoyed.
9. (live) ... in Oxford for two years, she spoke English like a native speaker.
10. (rescue) ..., the injured man was taken to hospital.

**Exercise 5. Rewrite the sentences without using the participle constructions.**

1. We were sitting around the fire singing songs.
2. Did you see the boy jumping up and down?
3. When going to London, they always did a sightseeing tour.
4. While being on the boat, Bob got seasick.
5. Being an exemplary pupil, he always does his homework.
6. Having told me the news, he went away.
7. The boy excited about the presents sat on the couch.
8. Sleeping in the garden, I didn't hear the telephone.
9. The children were sitting at the beach building a sandcastle.
10. Last month I read a book written by a Scottish author.

**Exercise 6. Change the Infinitives into the Present Participle or the Perfect Participle.**

1. (to eat) all the potatoes, she drank a cup of tea.
2. (to drink) tea, she scalded her lips.
3. (to look) through some magazines, I came across an interesting article

about UFOs. 4. (to write) out and (to learn) all the new words, he was able to translate the text easily. 5. (to live) in the south of our country, he cannot enjoy the beauty of Kiev in summer. 6. (to talk) to her neighbour in the street, she did not notice how a thief stole her money. 7. (to read) the story, she closed the book and put it on the shelf. 8. (to buy) some juice and cakes, we went home. 9. (to sit) near the fire, he felt very warm.

**Exercise 7. Change the Infinitives into the Present Participle or the Perfect Participle.**

1. (to translate) by a good specialist, the story preserved all the sparkling humour of the original. 2. (to approve) by the critics, the young author's story was accepted by a thick magazine. 3. (to wait) for some time in the hall, he was invited into the drawing-room. 4. (to wait) in the hall, he thought over the problem he was planning to discuss with the old lady. 5. They reached the oasis at last, (to walk) across the endless desert the whole day. 6. (to phone) the agency, he left (to say) he would be back in two hours. 7. (to write) in very bad handwriting, the letter was difficult to read. 8. (to spend) twenty years abroad, he was happy to be coming home. 9. She looked at the enormous bunch of roses with a happy smile, never (to give) such a wonderful present. 10. (not to wish) to discuss that difficult and painful problem, he changed the conversation.

**Exercise 8. Translate into English.**

1. Професор, який читає лекції другому курсу, відомий усій країні. 2. Лекція, прочитана професором, справила велике враження на аудиторію. 3. Прочитавши студентам лекцію, він вийшов з аудиторії. 4. Лектор, що прочитав цю лекцію, працює у нашому інституті. 5. Студенти завжди з цікавістю слухають лекції, що презентуються цим викладачем. 6. Читаючи лекції, він завжди наводить багато прикладів.

**Exercise 9. Transform the following sentences using participle phrases instead of the subordinate clauses.**

A. Model: The boys who live in this house formed a football team. — The boys living in this house formed a football team.

1. Most of the people who work at our factory have received comfortable flats in new houses. 2. Many pupils who learn English are members of our English club. 3. The man who sells newspapers showed me the way to the post-office. 4. The students who live on the left bank of the river cross this bridge twice a day. 5. The woman who teaches English at our school studied in England.

B. Model: The girls who are watering flowers are my friends. — The girls watering flowers are my friends.

1. The man who is making the report is our history teacher. 2. The workers who are repairing the road go home by bus. 3. The girl who is reciting the poem is our teacher's daughter. 4. The boys who are playing hockey live in our house. 5. The women who are working in the field go to the exhibition.

C. Model: When we arrived in London, we went sightseeing. — Arriving in London, we went sightseeing.

1. When she heard her name, she turned round. 2. When we saw our teacher, we stopped and waited for her. 3. When he came home, he switched on the TV set. 4. As I entered the hall, I saw my friends dancing round the fir-tree. 5. As I went out of the shop, I met my schoolmate.

D. Model: When I read this story, I came across many new words. — When reading this story, I came across many new words.

1. When the pupils discussed this novel, they expressed their thoughts in good literary language. 2. When Jane cooked dinner, she forgot to salt it. 3. When Paul studied at the University, he wrote several articles. 4. While I was waiting for you, I read this magazine.

E. Model: When she finished her work, she went home. — Having finished her work, she went home.

1. After we had passed our examinations we went to a summer camp. 2. As I had lost my key, I couldn't get in. 3. When Nick had a dictionary, he did not have to go to the reading-hall every day. 4. As we had booked tickets beforehand, we went to the theatre half an hour before the performance began. 5. After they received the telegram, they packed and left for Glasgow.

F. Model: We live in the city which was founded 1100 years ago. — We live in the city founded 1100 years ago.

1. We live in a house which was built last year. 2. She received a telegram which was sent yesterday; 3. I've got a TV set which was made in Japan. 4. The decisions which were adopted at the conference are supported by many scientists. 5. The machines which are made at our plant are exported to many countries of the world.

#### **Exercise 10. Replace one of the homogeneous predicates by Participle I.**

*Model: The girls walked home and sang. — The girls walked home singing.*

1. She looked at me and smiled. 2. The children sat and watched "television. 3. The girl spoke and trembled. 4. The children ran about and shouted. 5. He turned over the pages of a book and looked at the pictures. 6. The man read a book and made notes from time to time.

**Exercise 11. Transform the following complex sentences into simple ones using the Objective Participle Complex.**

*Model: I saw them as they were working in the field. — I saw them working in the field.*

1. I saw him as he was picking flowers in the park. 2. We watched them as they were playing hockey. 3. The teacher observed the pupils as they were writing compositions. 4. I saw the girl as she was crossing the street. 5. She watched him as he was repairing his car. 6. We saw wild geese as they were flying to the South.

**Exercise 12. Paraphrase the following using the Objective Participle Complex.**

*Model: The hair dresser did her hair. — She had her hair done.*

1. The tailor made a suit for him. 2. The worker repaired his car. 3. The photographer took a photograph of him. The typist typed his article for him. 5. The waitress brought them dinner. 6. His wife washed and ironed his shirt. 7. Their daughter cooked supper for them. 8. The porter brought his luggage into the car.

**Exercise 13. Transform the following complex sentences into simple ones using the Absolute Participle Complex.**

*A. Model: As the weather was fine, we went for a walk. — The weather being fine, we went for a walk.*

1. As my friend lives far from here, I go to his place by bus. 2. As the play was very popular, it was difficult to get tickets. 3. As it is rather cold, I put on my coat. 4. As his mother teaches English, he knows the language very well. 5. As her son was ill, she could not go to the theatre.

*B. Model: As my brother had locked the door, I couldn't get into the room. — My brother having locked the door, I couldn't get into the room.*

1. As our teacher had visited India, we asked him to tell us about that country. 2. When the match had ended, the people went home. 3. As my friend had bought the tickets beforehand, we did not need to hurry. 4. After the sun had risen, we continued our way. 5. As his sister has broken his spectacles, he had to buy a pair of new ones.

*C. Model: As the bridge was destroyed, we couldn't cross the river. — The bridge being destroyed; we couldn't cross the river.*

1. As all shops were closed, we couldn't buy anything. 2. As the road was being repaired, I couldn't go there by bus. 3. As the book was being printed, we hoped to get it soon. 4. As houses are built very quickly nowadays, we'll soon get a new flat. 5. As the waiting-room was being cleaned, the passengers were not let in.

D. Model; *When the work had been done, they went home. — The work having been done, they went home.*

1. When the house had been built, we got a new flat. 2. As the key had been lost, she couldn't get into the room. 3. As the road had been repaired, we could go there by bus. 4. When the waiting-room had been cleaned, the passengers were let in. 5. As all the tickets had been sold out, we couldn't see the performance.

**Exercise 14. Choose the correct sentence:**

1. a) I likes solving problems.  
b) They like solving problems.  
c) He like solving problems.  
d) They likes solving problems.
2. a) The car crash into the bus driving down the hill.  
b) The car crashed into the bus driving down the hill.  
c) The car has crashes into the bus driving down the hill.  
d) The car have crashed into the bus driving down the hill.
3. a) He was faking his illness.  
b) He were faking his illness.  
c) They is faking his illness.  
d) They was faking his illness.
4. a) They traces the lost dog.  
b) He trace the lost dog.  
c) I traces the lost dog.  
d) I traced the lost dog.
5. a) He offer to pay for the damage.  
b) I offers to pay for the damage.  
c) They offers to pay for the damage.  
d) They offered to pay for the damage.
6. a) I hopes to expand the market.  
b) They hopes to expand the market.  
c) I hope to expand the market.  
d) He hope to expand the market.
7. a) I heard my mother talking on the phone.  
b) I hears my mother talking on the phone.  
c) I has heard my mother talking on the phone.  
d) I hearing my mother talking on the phone.

8. a) Please remind me to get the book from the library.  
b) Please reminds me to get the book from the library.  
c) Please reminded me to get the book from the library.  
d) Please reminding me to get the book from the library.
9. a) Would they minds opening the window?  
b) Would you minded opening the window?  
c) Would you mind opening the window?  
d) Would you minds opening the window?
10. a) I plan to study till midnight.  
b) I plans to study till midnight.  
c) He plan to study till midnight.  
d) They plans to study till midnight.

**Exercise 15. Put a necessary form of the gerund instead of the infinitive.**

1. What is he doing? He is just trying (to open) the window. 2. Try (to taste) the meat before offering it to our guests. 3. Try (not to upset) yourself, darling. We must keep our heads. 4. You must try (to understand) what I say. 5. Try (to add) water to your drink. 6. Do you mind my trying (to mend) your watch? 7. Do you remember (to meet) her once at the dancing-party? 8. Please remember (to wipe) your feet before coming in. 9. I completely forgot (to turn off) the gas before leaving. 10. Don't forget (to take) your bathing things before setting off for the beach. 11. It is very hot this year. I am afraid you will regret (to come) to the South. 12. I greatly regret (to tell) you I am to go away. I am being waited for. 13. Your composition is very poor, I regret (to say). 14. Passing by a radio-shop he suddenly remembered (to buy) some cassettes for his recorder.

**Exercise 16. Translate into English using the Complex Object.**

1. Погана погода примусила нас повернутися додому. 2. Ми розраховуємо, що корабель прийде завтра. 3. Я бачив, як корабель зник за горизонтом. 4. Хвороба примусила його залишитися удома. 5. Мама хоче, щоб ми поїхали за місто. 6. Діти хотіли, щоб ялинку поставили в найбільшій кімнаті. 7. Ми розраховували, що він повернеться того ж дня. 8. Я наполягаю на тому, щоб ви пішли зі мною. 9. Я хочу, щоб ви допомогли мені. 10. Мама примусила мене поїхати на дачу в неділю. 11. Я бачив, як він пройшов мимо. 12. Я почув, як двері відчинилися. 13. Я хочу, щоб ви з'їздили до Франції.

**Exercise 12. Translate into English using the Complex Subject.**

1. Ніяк не чекали, що холодна погода наступить так рано. 2. Виявилось, що ми вже колись зустрічалися. 3. Ви, здається, втомилися. 4. Умови роботи виявилися більш важкими, чим передбачалося. 5. Ви випадково не знаєте цієї людини? 6. Книга, яку ви мені дали, виявилася нудною. 7. Нові автобуси виявилися дуже зручними. 8. З трьох сестер Бронте Шарлота вважається найталановитішою. 9. Ваш приятель, здається, дуже цікавиться стародавньою історією. 10. Вальтер Скотт вважається творцем історичного роману. 11. Я випадково знаю номер його телефону. 12. Він виявився хорошим спортсменом. 13. Я випадково зустрів його в Москві. 14. Відомо, що марсіанські канали були відкриті в 1877 році. 15. Припускають, що засідання закінчиться о десятій годині. 16. Джим виявився хоробрим хлопчиком.

**Test 1**

1. The language ... in Canada is English.  
a) to speak      b) speaking      c) spoken      d) speaks
2. The police caught him ... a car.  
a) to steal      b) stealing      c) stolen      d) to be stolen
3. A noise that disturbs someone is a ... noise.  
a) disturb      b) disturbance      c) disturbed      d) disturbing
4. These are the facts ... by the committee.  
a) to gather      b) gathering      c) gathered      d) being gathered
5. That is Mary ... over there.  
a) sitting      b) to sit      c) to be sat      d) being sat
6. I had my suit ... yesterday.  
a) to press      b) pressing      c) press      d) pressed
7. I am sorry to have kept you ... so long.  
a) to wait      b) waiting      c) be waiting      d) be waited
8. She kept her eyes ... all the time.  
a) to close      b) closing      c) close      d) closed
9. They got their car ... at the garage.  
a) to wash      b) washing      c) being washed      d) washed
10. Can Mary make herself ... in English?  
a) understood      b) understand      c) to understand      d) understanding

**Test 2**

1. A worker on an exhausting job is an ... worker.  
a) exhaust      b) exhausting      c) to exhaust      d) exhausted
2. The President was sitting on the chair ... by his supporters.  
a) surrounding      b) to surround      c) surrounded      d) surround

3. A beggar was dragging his weary feet with many kids ... behind.  
a) following    b) to follow    c) followed    d) being followed
4. Before ... to the college, he had to go through an examination.  
a) admitting    b) to admit    c) being admitted    d) having been admitted
5. I started the clock ... .  
a) to go    b) going    c) gone    d) to be gone
6. The room is crowded, but there are ... .  
a) a few seats to leave    b) few seats left    c) a few seats left    d) few seats to leave
7. The dog, ... , will make a good watch dog.  
a) to train properly    b) training properly    c) properly to train    d) trained properly
8. ... with mine, your audio components are rather expensive.  
a) comparing    b) to compare    c) to be compared    d) compared
9. How was the concert last night? " It was ... "  
a) disappointing    b) disappointed    c) disappoint    d) disappointment
10. All the students felt ... listening to his lecture.  
a) bored    b) boring    c) to bore    d) bore

### Test 3

1. A ... man will catch at a straw.  
a) drowned    b) to drown    c) drowning    d) being drowning
2. The gentleman sitting with his arms ... was my boss.  
a) folding    b) to fold    c) folded    d) being folded
3. ... his answer, she sent the second letter.  
a) Receiving not    b) Not to receive    c) Not being received    d) Not having received
4. I saw Professor Lee ... in the library last night.  
a) works    b) to work    c) working    d) worked
5. The concert conducted by Karajan proved very ... .  
a) exciting    b) excited    c) to excite    d) being excited
6. Our school, ... on a hill, commands a fine view.  
a) located    b) locating    c) having located    d) to locate
7. A man was killed. " Where is the body of the ... man?"  
a) murder    b) murdered    c) murdering    d) having murdered
8. ... all things into consideration, his life is a happy one.  
a) Taking    b) Having taken    c) Take    d) To take
9. Beethoven wasted too much time ... his symphony No. 9.  
a) composed    b) being composed    c) compose    d) composing
10. The name Nebraska comes from the Oto Indian word "nebrathka," ... flat water.  
a) to mean    b) meaning    c) it means    d) by meaning

### Test 4

1. When I returned home, I found the window open and something ... .  
a) to steal    b) stealing    c) stolen    d) stole

2. ... that the train is gone, it is useless to wait.  
a) Seen            b) Seeing            c) Having seen            d) To see
3. Standing, ... on a hill, his villa commands a fine view.  
a) as it is            b) as it was            c) as he does            d) as it does
4. Walking along the riverside path, ... .  
a) I met several groups of hikers b) the river met several groups of hikers c) it was several groups of hikers            d) we met by several groups of hikers
5. Hidden ... by a big tree, his house was not to be seen.  
a) as it was            b) as it is            c) as it did            d) as he did
6. Standing, ... on a hill, his villa commands a fine view.  
a) as it is            b) as it was            c) as he does            d) as it does
7. We will go for a walk in the Grand Park tomorrow, weather ... .  
a) permitting            b) to permit            c) permitted            d) having permitted
8. My father encouraged me in my painting, but never lived to see any of my works ... in public.  
a) exhibiting            b) exhibited            c) having exhibited            d) exhibit
9. Asked if he could come to the party that night, ... .  
a) nobody said anything.            b) they did not get an answer from him.  
c) nothing was said by him.            d) Tom nodded his head and left the room.
10. ... that the train is gone, it is useless to wait.  
a) Seen            b) Seeing            c) Having seen            d) To see

### Test 5

1. She turned to me for help, ... how to deal with the problem.  
a) not being known            b) not knowing            c) not having known            d) not known
2. A ... kindness deserves no thanks.  
a) forcing            b) forced            c) having forced            d) to force
3. I want my phone number ... because people often get the wrong number.  
a) changed            b) having changed            c) being changed            d) be changed
4. The captain watched the sailors ... the steamer.  
a) unloading            b) having unloaded            c) unload            d) unloaded
5. Mrs. Green doesn't explain things well. Her explanations are ... .  
a) confused            b) confusing            c) being confused            d) confuses
6. ... to see as much as possible of the town, we hired a car.  
a) Having wished            b) Wishing            c) Wished            d) Has wished
7. The girl was sitting with her back to the window, her head half ... .  
a) being turned            b) having been turned            c) turned            d) to turn
8. Lester Fisher was standing at his office window ... to the street below.  
a) looking down            b) look down            c) having looked down            d) looked down
9. Going back to his office, Fisher had a ... feeling of strong anger and mild grief.  
a) mixing            b) mixed            c) being mixed            d) be mixed
10. Alice didn't like her Biology classes; she thought they were ... .  
a) bored            b) being boring            c) boring            d) being bored

## LESSON IV

### Text

**Exercise 1. Translate the text using a list of unknown words.**

### **A dual indicator approach for monitoring benthic impacts from organic enrichment with test application near Atlantic salmon farms**

Peter J. Cranford<sup>a, \*</sup>, Lindsay Brager<sup>a</sup>, David Wong<sup>b</sup>

<sup>a</sup> Fisheries and Oceans Canada, Bedford Institute of Oceanography, 1 Challenger Dr., Dartmouth, Nova Scotia B2Y 4A2, Canada

<sup>b</sup> Fisheries and Oceans Canada, St. Andrews Biological Station, 531 Brandy Cove Rd., St. Andrews, New Brunswick E5B 2L9, Canada

### **Abstract**

The organic enrichment of surficial sediments has a known effect on benthic faunal communities due largely to oxygen depletion and sulfide toxicity. Total dissolved sulfide (free  $S^{2-}=H_2S+HS^-+S^{2-}$ ) concentrations in sediments are widely measured as a practical indicator of community effects. However, the standard ion selective electrode (ISE) method for free  $S^{2-}$  analysis can provide biased results owing to the inclusion of nontoxic mineral sulfides and the oxidation and volatilization of free  $S^{2-}$ . A rapid field protocol was developed that alleviates these problems while also providing data on dissolved oxygen concentrations. Sediments collected near salmon aquaculture pens over cohesive and permeable substrates were analysed using the standard and new protocols. The results confirm previous conclusions of artifacts with the standard ISE method, while the dual indicator approach more accurately describes the stages, spatial extent and magnitude of sediment geochemical alterations affecting benthic communities.

### **1 Introduction**

Eutrophication is considered a major anthropogenic perturbation to marine ecosystems worldwide and is one of the largest threats to coastal ecosystems. Organic matter enrichment of surface sediments, resulting from the presence of excess nutrients in coastal areas and the release of solid effluents from some human activities (e.g. sewage, pulp and paper, and aquaculture), has a known effect on benthic habitat and microbial and faunal communities (e.g. Pearson and Rosenberg, 1978). Organic matter deposition stimulates benthic aerobic metabolism and hypoxic/anoxic conditions are created in surficial sediments if oxygen consumption exceeds resupply across the sediment-water interface. Under anoxic conditions, sulfate reducing bacteria continue to decompose the organic matter and produce hydrogen sulfide as an end-product of sulfate respiration.  $H_2S$  and ionization products ( $HS^-$  and  $S^{2-}$ ) are toxic to most organisms. The concentration of these sulfide forms, which exist in a dissolved state, is a function of pH and are collectively reported as total dissolved sulfides (free  $S^{2-}=H_2S+HS^-+S^{2-}$ ).

The diversity, abundance and biomass of benthic species are known to change in a predictable pattern along an organic enrichment gradient, largely in response to changes in oxygen availability and free  $S^{2-}$  toxicity (Pearson and Rosenberg, 1978). Agreement with the Pearson-Rosenberg qualitative model of benthic community effects from increasing organic enrichment has been widely reported. Hargrave et al. (2008) developed a unified quantitative model of how benthic community structure responds to organic enrichment-induced changes in the biogeochemical properties of surface sediments. This model showed that organic enrichment effects on benthic macrofauna could be classified based on simple geochemical measurements (pH, redox potential and free  $S^{2-}$ ) such that these measures can support and/or act as alternatives to the costly, labour-intensive and time-consuming taxonomic approach for assessing benthic effects.

Several countries, including Canada, New Zealand and USA, include free  $S^{2-}$  monitoring as part of the benthic component of aquaculture management frameworks (Wilson et al., 2009). The Canadian Aquaculture Activities Regulations (GoC, 2015) and related Monitoring Standard (DFO, 2015) place a particularly heavy reliance on free  $S^{2-}$  monitoring and related organic enrichment standards for environmental impact assessments; as opposed to also employing biological standards (Wilson et al., 2009). The standard protocol for measuring free  $S^{2-}$  in surficial sediments employs the ion-selective electrode (ISE) method that is based on the principle that the potential of a silver/sulfide ISE is related to sulfide ion activity in the sediment pore water (DFO, 2015). This method has been widely adopted as it allows measurements to be made in the field using relatively inexpensive, commercially available, and portable instruments. Free  $S^{2-}$  measurements are performed by inserting the  $Ag^+/S^{2-}$  probe directly into a sediment pore water slurry containing an alkaline buffer (sulfide antioxidant buffer; SAOB) (e.g. Wildish et al., 1999). The addition of SAOB is required to regulate the ionic strength of the solution, to reduce loss of free  $S^{2-}$  by oxidation and to adjust pH to  $> 13$ . The alkaline conditions are necessary to ensure that any  $H_2S$  and  $HS^-$  in the sample are in the form of  $S^{2-}$ , which is specifically detected by the ISE. Brown et al. (2011) reported that this accepted protocol "... can lead to significant bias of free sulfide measurements, with orders of magnitude higher concentration detected in the buffered sediment pore water slurry than in pore water samples isolated and analysed separately." These authors also noted that the accepted sediment analysis protocol exhibited low precision compared with measurements conducted in aqueous solutions ( $SE \pm 55\%$  and  $12\%$ , respectively). These errors have been attributed to the dissolution of particulate sulfides and/or sulfur present in the sediment under the intense alkaline conditions required by the method (Brown et al., 2011). Consequently, there is a need for a more accurate and precise protocol for measuring total free sulfides in sediments, but which also remains practical for application in routine environmental assessments.

Although the availability of oxygen in marine sediments is an integral component of the Pearson and Rosenberg (1978) and Hargrave et al. (2008) organic enrichment zonation models, oxygen concentration measurements have seldom been included in studies dealing with the benthic impacts of excess organic enrichment (Kalantzi and Karakassis, 2006; Giles, 2008). The depth of the redox potential (Eh) discontinuity provides an indication of the depth of oxygen penetration, but Eh microelectrode measurements have been discounted as a reliable indicator of benthic impacts due to poor precision, particularly in areas with oxic sediments. A combination of dissolved oxygen and free  $S^{2-}$  measurements in surface sediments, using reliable and practical methodologies, would provide information on benthic oxygen stress and sulfide toxicity and the consequences to benthic fauna from excess organic matter sedimentation.

The present study included the development of a combined protocol for accurately and precisely measuring free  $S^{2-}$  and dissolved  $O_2$  in sediment samples immediately after sample collection under field conditions. The reported free  $S^{2-}$  method eliminates interference from particulate sulfur forms while also preventing additional errors from the rapid oxidation and volatilization of free  $S^{2-}$  in samples during sample processing and transport. Commercially available dissolved oxygen microsensors and microelectrodes were tested for compatibility with the sampling protocol developed for free  $S^{2-}$  analysis. All methods were validated based on measurement accuracy, precision and limit of detection and were tested under typical environmental monitoring conditions near open-water salmon net-pens located over permeable (sand) and cohesive (mud) seabeds.

## **2 Materials and methods**

### **2.1 Methods development criteria**

The sample processing and analytical procedures are targeted for both scientific and regulatory applications. The principal requirements were that the methods provide accurate and precise results across the full range of dissolved oxygen and free  $S^{2-}$  concentrations possible in natural and impacted substrates. Other developmental considerations, particularly for regulatory applications, included: ease of use by non-professionals; high rate of sample processing and analysis; relatively low cost per sample (e.g. salary, instrumentation, expendables and materials life-cycle); and applicability for near real-time analysis on the sampling vessel. The latter requirement is important to determine if resampling is necessary to confirm any anomalous results. The strategy taken to eliminate free  $S^{2-}$  measurement errors related to contamination by the presence of particulate species, volatilization and/or reactivity with atmospheric oxygen, was to isolate the pore water from the sediment and to conduct all pore water analysis prior to any sample contact with air.

### **2.2 Pore water collection**

The decision to focus on sediment pore water analysis required a sample collection and extraction protocol that prevents the fluid from being displaced from the desired sampling depth during sampling, while also preventing contact with air. Immediate extraction of porewater in the field helps to facilitate these requirements. Porewater collection without contact with air is problematic for many of the extraction methods currently reported, including dialysis, suction filtration, centrifuging and squeezing (reviewed by Shotbolt, 2010). The Rhizon sampler approach, however, has been reported to be a cost-effective and technically easy method that can provide pore water samples without changing redox conditions in the sample. Two types of Rhizon samplers (Rhizosphere Research Products, Wageningen) were tested in field and laboratory conditions. The standard Rhizon consisted of a hydrophilic, porous, polymer tube (5 cm long) with a diameter of 2.5 mm and mean pore size of 0.15  $\mu\text{m}$ . A stainless steel wire inside the tube provided support for the flexible tube during insertion into sediment. The porous tube is attached to a 12 cm length of 2.5 mm diameter PVC/PE tubing and terminated with a nylon luer-lock connector. The RhizoCera sampler consisted of a 5 cm long ceramic ( $\text{Al}_2\text{O}_3$ ) tube with a diameter of 4 mm and pore size of 0.7  $\mu\text{m}$ . The luer connector is attached directly to the ceramic tube. Both samplers are porous only to liquids and can be used repeatedly after back-flushing.

Porewater was extracted from sediment samples collected by coring (coring details provided below). The Rhizon or RhizoCera samplers were inserted horizontally into the side of clear polycarbonate core tubes at the desired depth below the sediment/water interface. The 10.8 cm-diameter polycarbonate core tubes contained holes, drilled at 1 cm intervals along the length of the tube, which were covered with clear duct tape. The tape is meant to provide a tight seal against the outside of a fully inserted pore water sampler to prevent fluid leakage from the core and air exchange with the sediment. The sampler was connected to a syringe and approximately 1 mL of pore water was manually extracted from the core under gentle suction. This volume was sufficient to both fill and flush the inside of the Rhizon and RhizoCera tubes. The fluid in the syringe was discarded as the analysis of porewater was conducted only on material retained inside the sampler tube. This was accomplished by removal of 100  $\mu\text{L}$  subsamples from inside each tube with a micro-syringe for free  $\text{S}^{2-}$  analysis and by inserting an oxygen microsensor inside the Rhizon/RhizoCera tube. This procedure fulfilled the requirement for pore water sampling/analysis to be conducted without the sample contacting air.

### **2.3 UV spectrophotometric determination of total free sulfide**

The ultraviolet spectrophotometric method for determination of free  $\text{S}^{2-}$  concentrations in water was adapted as a rapid approach for the routine analysis of pore water samples in the field. This is a direct method in which the bisulfide ion ( $\text{HS}^-$ ) is detected directly via its intrinsic optical properties.  $\text{HS}^-$  absorbs in

the ultraviolet with a peak near 230 nm and, when measured at pH near 8, this method provides accurate and precise measurements of total free  $S^{2-}$  concentrations in natural waters. Given that no chemical manipulations are required with this method, other than adjusting pH, and the capacity to measure high concentrations without dilution, it was identified as a practical approach for use under typical field conditions. The revised method described below requires a UV spectrophotometer with a stable light source and 1 nm accuracy across a spectral range of 200 to 250 nm.

Initial tests with the UV spectrophotometric method confirmed the high sensitivity to  $HS^-$  at 230 nm such that absorbance becomes nonlinear at concentrations above approximately 300  $\mu M$ . To permit the routine measurement of a wider range of free  $S^{2-}$  concentrations present in natural and organically enriched sediments, all measurements were performed by adding 100  $\mu L$  of pore water or working standard to a cuvette containing 1 mL of deoxygenated and deionized water (DDW; Millipore, Milli-Q system). This dilution water was first adjusted to between pH 8 and 9 with ammonium hydroxide (0.44 M). This approach ensured proper pH conditions for measuring total free  $S^{2-}$  while also expanding the concentration range to approximately 3000  $\mu M$  for measurements at the spectral peak. Higher concentrations can be measured from the same absorption spectra by shifting the absorption wavelength above the spectral peak at 230 nm (Guenther et al., 2001), and applying the applicable calibration as described below. The accuracy and robustness (i.e. reliability during normal usage despite deliberate variations in method parameters) of the method was determined by conducting multiple instrument calibrations over a 100 days period using bisulfide standards prepared in DDW.

## **2.4 Dissolved oxygen**

Dissolved oxygen concentrations in pore water were measured using fast-response microprobes (90% in < 10 s) with tip diameters < 1.5 mm to allow insertion of the probe inside the pore water sampler tube. Measurements were taken with either a Clarke-type sensor (Unisense Monometer with OX-N needle-type probe; Unisense A/S, Aarhus, Denmark) or a micro-optode sensor (Microx 4 m with NTH-PSt7 needle type microsensor; PreSens - Precision Sensing GmbH, Regensburg, Germany). Both systems included temperature compensation probes that were inserted directly into the sediment core during oxygen measurements. All oxygen probes were calibrated immediately prior to use by a two-point approach in which readings were taken in air-saturated and deoxygenated ( $N_2$  gas bubbled) seawater. The Clarke-type sensors were allowed to stabilize (platinum cathode becomes polarized) for at least 1 h prior to calibration and sample analysis.

The capacity of the Rhizon and RhizoCera pore water samplers to provide representative oxygen concentrations was assessed by comparing measurements

taken inside a core tube filled with seawater and after filtration through a porewater sampler inserted through the side of the core tube. The seawater was initially deoxygenated with N<sub>2</sub> gas and the water was then filtered through the pore water sampler. Sequential measurements were taken with a PreSens micro-optode as the oxygen concentration increased inside the core tube.

## 2.5 Sediment sampling near salmon net pens

Sediment samples for methods testing and comparison were collected at two Atlantic salmon (*Salmo salar*) farms in eastern Canada. The farms were selected specifically to include fine (mud) and coarse (sand) sediment types. Sampling of mud bottoms was conducted in the macro-tidal Passamaquoddy Bay at a farm containing 15 circular floating collar net-pens. The site has an average tidal range of 7 m and water depth of 23 m. The farm with the sand seabed was located on the Atlantic coast of Nova Scotia near the mouth of Jordan Bay (43° 42.0' N, 65° 11.7' W; mean depth= 13 m; mean tidal range = 1.5 m) and consisted of 20 net-pens. Each salmon pen is known to contain between 30,000 to 50,000 fish, giving a minimum of 450,000 and 600,000 fish at the mud and sand farms, respectively. Other salmon farms in each region were located several km away from the study sites. Both farms contained fish near market size during sampling and feeding was underway during the sampling periods.

Sampling along a presumed organic enrichment gradient was conducted at each farm between September 15 and October 16, 2016 by collecting replicate cores (n = 3 to 20) at five locations extending from the edge of the net-pens out to 1000 m. The sample size varied between sampling locations owing to changing weather conditions. Additional sediment samples were collected at the same farms between April 2 and May 25, 2017. A specialized coring device, called a “mini slo-corer” (described by Milligan and Law, 2013) was used to collect cores with an undisturbed sediment-water interface. The open structure of the corer reduces the formation of a bow (дуга) wave on descent. Once the corer is on the bottom, hydraulic damping controls the rate at which a 30 kg weight drives the 10 cm diameter polycarbonate core tube into the sediment. The top of the core is sealed by a valve after the core barrel is imbedded in the sediment and a plate seals the bottom of the core as it is withdrawn. The corer weighs 70 kg and can be deployed from small vessels. The core tubes were drilled and taped as described above to allow for porewater removal.

Porewater samples were immediately extracted onboard the sampling vessel from 1 and 2 cm depths below the sediment-water interface using RhizoCera samplers. Note that all sampling depths are  $\pm 0.5$  cm as a result of the 0 cm hole not exactly aligning with the sediment surface and variability in surface topography. A 100  $\mu$ L subsample was removed from each RhizoCera for immediate determination of free S<sup>2-</sup>. O<sub>2</sub> concentrations were then determined by inserting a Unisense Clarke-type microsensor into the RhizoCera tube and the temperature sensor directly into the sediment. Salinity was measured in the

overlying water using a YSI EcoSense EC300A meter and probe. Salinity, atmospheric pressure and core temperature data were used to correct oxygen readings using equations developed by Benson and Krause (1984) for solubility in water. The core was then drained to the sediment-water interface and 5 mL of the upper 2 cm of sediment was subsampled in triplicate using cut-off 5-mL plastic disposable syringes. The syringes were filled by withdrawing the barrel as the syringe was inserted into the upper 2 cm surface layer. These replicate samples were capped and stored at 4 °C until analysis the same day by the standard ISE method (Wildish et al., 1999; Brown et al., 2011). The core was extruded from the tube and the upper 1 cm of sediment was retained for organic matter analysis (weight loss to nearest 0.01 mg from dry sediment during ignition at 450 °C for 6 h) and inorganic grain size determination. Sediment for grain size analysis was digested with 30% hydrogen peroxide and disaggregated with an ultrasonic probe. Samples from the cohesive sediment site were analysed with a Beckman Coulter Multisizer 3 while the sandy sediments collected at the second farm were analysed using a Beckman Coulter LS 13320 Laser Diffraction Particle Size Analyzer. P.J. Cranford et al. Marine Pollution Bulletin 124 (2017) 258–265. Statistical analysis Separate paired t-tests were performed for each salmon farm to address the hypothesis that average free  $S^{2-}$  concentrations obtained with the standard ISE and UV spectrophotometric protocols were equal. Given that the ISE method provided depth integrated concentrations (0 to 2 cm depth), the two depths analysed with the UV method (1 and 2 cm) were averaged prior to conducting these tests. One-way multivariate analysis of variance (MANOVA) was employed to assess the hypothesis of no mean effect of the five sampling location on the dependents (free  $S^{2-}$  and  $O_2$  levels) at the two farms. The Pillai Trace multivariate test statistic was used to test this hypothesis. The dependent(s) involved in significant MANOVA results was determined from univariate F-tests provided along with the MANOVA results. Post hoc multiple comparison tests were then conducted to determine the effect of location on each dependent. This was limited to comparisons between the reference site (farthest station from the farm) and the other four locations. Data employed for all inferential statistics were prescreened to ensure normality and homoscedasticity by examining normal probability and residual plots. All tests were conducted at  $\alpha = 0.05$  using SYSTAT 13 (SYSTAT Software, Inc., Chicago, USA).

### 3 Discussion

The field determination of total free  $S^{2-}$  in surficial sediments, based on the reported ultraviolet spectrophotometric protocol, is fast, accurate, sensitive and applicable to the full range of concentrations encountered in natural and organically enriched marine substrates. Analysis of pore waters, as opposed to sediment/water slurries, removes the potential for contamination by particulate sulfides and/or sulfur that can cause analyte overestimation. Comparison of

results obtained by the standard ISE and UV methods confirm reports of the low accuracy of results obtained using the ISE protocol (Brown et al., 2011) and, in addition, show that the ISE protocol can both over- and underestimate the true concentration of free  $S^{2-}$  present in marine sediment. Underestimation apparently results from a combination of free  $S^{2-}$  oxidation and/or volatilization during sampling, storage and transport of sediment samples to the laboratory; even when the analysis is conducted on the same day as sample collection. The standard ISE sampling protocol mixes sediments from 0 to 2 cm depth, allowing  $O_2$  in surface sediments to mix with any free  $S^{2-}$  accumulated below this layer. This mixing permits chemical and biological oxidation of free  $S^{2-}$ , leading to the underestimation of the actual concentration. The protocol presented herein prevents free  $S^{2-}$  loss by; 1) sampling across smaller depth intervals (discussed below), 2) elimination of sample contact with the atmosphere prior to analysis, and 3) immediately conducting analysis in the field to prevent sample alteration during transport and storage. Field analysis also has the advantage of permitting immediate resampling in the event of obtaining anomalous results, or to confirm observations of concentrations exceeding regulatory thresholds.

Guenther et al. (2001) outlined some of the advantages of the direct UV method for determination of total free  $S^{2-}$ , relative to a wide range of available methods including colorimetric (e.g. methylene blue), electrochemical and gas chromatography approaches. The relative simplicity of detecting the analyte via its intrinsic optical property, without the need for additional dilution of high concentrations or the use of hazardous chemicals, is particularly advantageous for field applications. The robustness of the direct UV analytical procedure was demonstrated by the high stability of the instrument calibration over time and insignificant differences in calibration coefficients obtained using different spectrophotometers. This inherent stability reduces the need for frequent calibrations, although periodic instrument validation is recommended and generally required for meeting regulatory quality control standards.

The need to remove particulate interference with free  $S^{2-}$  measurements required a practical method for rapid pore water extraction in the field. This was greatly facilitated by the small volumes required for sample analysis (approximately 1 mL needed for sampler flushing and analysis of both  $O_2$  and free  $S^{2-}$ ). Porewater yield is reported by the manufacturer at approximately 4 mL  $\text{min}^{-1}$  for the Rhizon and 0.5 mL  $\text{min}^{-1}$  for the RhizoCera. The latter sampler worked best for the present application, as indicated by the lack of atmospheric oxygen intrusion into the sample and the resulting capacity to measure anoxic conditions. The sample extraction procedure with the RhizoCera was routinely completed on board the sampling vessel within 2 min for both mud and sand core samples, with free  $S^{2-}$  and  $O_2$  analysis subsequently conducted in near real-time. In the present study, pore water sampling was performed at 1 and 2 cm depths to facilitate comparison of results with the standard ISE protocol, which provides an integrated measure for the surface layer (0 to 2 cm depth). Rhizon

samplers have been shown to collect pore water with a vertical resolution of approximately 0.2 cm for extraction of 1 mL samples. This small area of influence permits vertical profiling of surficial sediment geochemical conditions.

As noted above, overestimation of free  $S^{2-}$  measurements by the standard ISE protocol have been attributed to the presence of metal sulfides complexes in the sediment that dissolve in the alkaline antioxidant buffer. The largest error was detected immediately next to the salmon net-pens over sandy sediments, where concentrations in sediment/water slurries averaged 7.5 times higher than was measured in the porewater. Brown et al. (2011) reported a similar magnitude of error for salmon aquaculture sites in British Columbia, Canada. However, the degree of bias may be expected to be site-specific depending on sediment mineralogy. The lack of a similar measurement bias at greater distances from the same farm suggests that the availability of metal sulfides may be related to previous organic enrichment of sediments near the farm. If dissolved iron oxides are present, free  $S^{2-}$  can be removed from solution by precipitation to iron sulfide (FeS) and pyrite (FeS<sub>2</sub>). The enhancement of authigenic metal sulfides in sediments close to an organic enrichment source is a reasonable expectation and the creation of sediment microenvironments will cause spatially-variable effects on the detection of free  $S^{2-}$  by the standard ISE approach. Free  $S^{2-}$  buffering via the presence of reactive Fe in marine sediments is known to play a significant role in the mitigation of sediment eutrophication by reducing the chemical O<sub>2</sub> demand for sulfide oxidation, and reducing free  $S^{2-}$  accumulation through precipitation. The presence of free  $S^{2-}$  above background levels indicates that reactive Fe is either not present or has been consumed. This buffering effect appears to apply more for the farm with the sandy substrate (minimal local enhancement of free  $S^{2-}$  with large ISE overestimation from mineral sulfide dissolution) than for the site with cohesive sediments (local enhancement of free  $S^{2-}$  with low ISE error).

A low detection limit for total free  $S^{2-}$  is required for assessing differences between reference and impacted sites, particularly when conducting statistical inferences. Concentrations measured at distances > 50 m from the two salmon farms ranged from 10 to 350  $\mu$ M. The limit of detection of the UV method averaged 3.7  $\mu$ M, which was adequate for characterizing natural conditions at the study sites and for most locations previously studied. As noted above, Eh microelectrode measurements have been excluded as a reliable indicator of benthic impacts due to low precision (high LOD) under natural conditions and a poor correlation with free  $S^{2-}$  in areas with oxic sediments. Eh measurements have traditionally been used as a secondary indicator to support sediment oxic status classifications based on free  $S^{2-}$  measurements. To provide additional support for management decisions based primarily on free  $S^{2-}$  measurements, the reported sampling protocol was developed to also permit the accurate determination of dissolved O<sub>2</sub> levels in pore waters. Rapid-response

microsensors (optodes and Clarke-type) are commercially available that are small enough for performing O<sub>2</sub> measurements inside the pore water samplers. Practical instrument choice considerations for field analysis include; durability, response time, battery operation and auto-compensation for temperature, pressure and salinity variations. The types of probes used in the present study met the essential requirements for speed and accuracy, although the PreSens syringe micro-optodes were fragile while the Unisense Clarke-type needle probes required more frequent calibration and post-processing of field data. More robust needle-type optodes are currently available from these and other sources and have been incorporated into ongoing studies.

Analysis of spatial trends in benthic impact parameters at fish farms by Giles (2008) indicated that impacts are largely confined to a radius of  $\leq 70$  m around the farm. However, changes in benthic diversity have been detected and predicted at greater distances (Borja et al., 2009; Edgar et al., 2010; Zhulay et al., 2015). Significant spatial effects on mean free S<sup>2-</sup> and O<sub>2</sub> levels were detected at both farms. Elevated free S<sup>2-</sup> concentrations were largely observed immediately adjacent to the farms. However, pore water O<sub>2</sub> concentrations in the sand substrate were affected at distances up to at least 425 m from this farm, with the greatest effect measured at 2 cm depth. Variability in O<sub>2</sub> levels was lowest near the net-pens while free S<sup>2-</sup> variability was highest at these same sampling sites. These spatial trends suggest the presence of an advanced stage of hypoxic stress (“severe” classification with O<sub>2</sub> < 0.7 mg L<sup>-1</sup>; Diaz and Rosenberg, 1995) and an early stage of sulfidic stress immediately adjacent to the net-pens. In contrast, the organic enrichment indicator nomogram and unified sediment classification scheme presented by Hargrave et al. (2008) equates severe hypoxic stress with much higher free S<sup>2-</sup> levels (> 3000  $\mu$ M). This apparent contradiction results from differences in sampling protocols. The Hargrave et al. (2008) classification scheme is based on the standard ISE sampling/analysis protocol that mixes sediments from 0 to 2 cm depth; allowing O<sub>2</sub> and free S<sup>2-</sup> to briefly coexist in the same sample. This scheme assumes that O<sub>2</sub> levels are correlated with free S<sup>2-</sup> concentrations and follow parallel changes with increasing organic enrichment. However, free S<sup>2-</sup> only accumulates in surficial sediments after dissolved O<sub>2</sub> is severely depleted. The present sampling protocol avoids the mixing of sediment layers.

The use of a dual indicator approach that separates dissolved O<sub>2</sub> and free S<sup>2-</sup> sediment organic enrichment classifications would provide a greater understanding of the stages and specific causes of benthic community effects at a given location, and would permit monitoring across a broader range of benthic conditions. A single-indicator approach based on free S<sup>2-</sup> monitoring is only applicable to areas with naturally occurring hypoxic surficial sediment conditions. This approach is not appropriate for sites with oxic sediments because biodiversity reduction thresholds (e.g. 50% species reduction) can be exceeded through O<sub>2</sub> depletion alone, prior to any significant increase in free

$S^{2-}$ . Hypoxia effects on benthic biodiversity are well known and critical thresholds have been reported (Diaz and Rosenberg, 1995; Gray et al., 2002; Vaquer-Sunyer and Duarte, 2008) that can be applied for regulatory management. Although threshold values for free  $S^{2-}$  levels in surficial sediments have also been reported for the classification of the organic enrichment status of marine sediments (Hargrave et al., 2008), the methodological artifacts identified herein could have biased the actual degree of impact on benthic community diversity. This obviates the need for a direct comparison of benthic diversity with free  $S^{2-}$  results obtained using the protocols developed in the present study, including results obtained across a range of benthic habitats and degrees of organic enrichment. Such a study is needed to develop a revised classification scheme for describing the organic enrichment status of marine sediment based on accurate measurements of total free  $S^{2-}$  concentrations.

#### **4 Acknowledgements**

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#### **Exercise 2. Translate and study the following words and expressions:**

Post hoc, porewater, enrichment, surficial sediments, benthic faunal communities, dissolved, inclusion, to alleviate, salmon aquaculture pens, cohesive and permeable substrates, to confirm, conclusions, the dual indicator approach, spatial extent, geochemical alterations, a major anthropogenic perturbation, solid effluents, sewage, pulp, to exceed, the diversity, abundance and biomass of benthic species, a predictable pattern, an organic enrichment gradient, in response to, availability, a unified quantitative model, portable instruments, to adjust, magnitude, separately, to exhibit, aqueous solutions, depth, measurements, a reliable indicator, to eliminate, principal requirements, porous, liquids, back-flushing, a tight seal, against, to prevent fluid leakage, determination, the routine analysis, initial tests, sensitivity.

#### **Exercise 3. Answer the questions:**

1. What effects on benthic faunal communities?
2. What is widely measured as a practical indicator of community effects?
3. What way were sediments collected near salmon aquaculture pens over cohesive and permeable substrates analysed?
4. What is eutrophication?

5. What happens if oxygen consumption exceeds resupply across the sediment-water interface?
6. What was adapted as a rapid approach for the routine analysis of pore water samples in the field?
7. What would provide information on benthic oxygen stress and sulfide toxicity and the consequences to benthic fauna from excess organic matter sedimentation?
8. What way all oxygen probes were calibrated?
9. What did analysis of spatial trends in benthic impact parameters at fish farms by Giles (2008) indicated?
10. What reduces the need for frequent calibrations?
11. What approach based on free  $S^{2-}$  monitoring is applicable to areas with naturally occurring hypoxic surficial sediment conditions?
12. What was developed to provide additional support for management decisions based primarily on free  $S^{2-}$  measurements?
13. What did the types of probes used in the present study meet?
14. What did the present sampling protocol avoid?
15. What was this work funded by?

**Exercise 4. Make up as more sentences as you can using the words and expressions from exercise 2.**

**Exercise 5. Make up 25 different type questions for this text.**

**Exercise 6. Write a brief summary of the text.**

*Note that:*

- A summary begins with an introductory sentence that states the article's title.
- A summary must contain the main thesis or standpoint of the text, restated in your own words.
- A summary is written in your own words.
- A summary is always shorter than the original text, often about 1/3 as long as the original.

**Exercise 7. Read your summary of the text to your groupmate and ask him to retell it.**

**Exercise 8. Make up a plan of this text. Retell the text according to it.**

## ***GRAMMAR***

### **Conditionals**

Conditionals describe the result of something that might happen (in the present or future) or might have happened but didn't (in the past). They are made using different English verb tenses.

There are four main kinds of conditionals:

### The Zero Conditional:

A zero conditional sentence can be made with two present simple verbs (one in the 'if clause' and one in the 'main clause'):

If + present simple, .... present simple.

This conditional is used when the result will always happen. So, if water reaches 100 degrees, it always boils. It's a fact. It is in general, not one particular situation. The result of the 'if clause' is always the main clause.

The 'if' in this conditional can usually be replaced by 'when' without changing the meaning. For example: If water **reaches** 100 degrees, it **boils**. (It is always true, there can't be a different result sometimes).

If I **eat** peanuts, I **am** sick. (This is true only for me, maybe, not for everyone, but it's still true that I'm sick every time I eat peanuts)

If people **eat** too much, they **get** fat.

If you **touch** a fire, you **get** burned.

People **die** if they **don't eat**.

Snakes **bite** if they **are** scared

The first conditional is about a specific situation, but the zero is talking in general.

### The First Conditional:

(if + present simple, ... will + infinitive)

It is used to talk about things which might happen in the future. Of course, we can't know what will happen in the future, but this describes possible things, which could easily come true.

If it rains tomorrow, we'll go to the cinema.

She'll **be** late if the train **is** delayed.

She'll **miss** the bus if she **doesn't leave** soon.

If I **see** her, I'll **tell** her.

### The Second Conditional:

(if + past simple, ... would + infinitive)

If I had a lot of money, I would travel around the world.

First, they can be used talking about things in the future that are probably not going to be true. Maybe somebody is imagining some dream for example.

If I **won** the lottery, I **would buy** a big house. (I probably won't win the lottery)

If I **met** the Queen of England, I **would say** hello.

She **would travel** all over the world if she **were** rich.

She **would pass** the exam if she ever **studied**. (She never studies, so this won't happen)

Second, they can be used talking about something in the present which is impossible, because it's not true.

If I **had** his number, I **would call** him. (I don't have his number now, so it's impossible for me to call him).

If I **were** you, I **wouldn't go** out with that man.

## The Third Conditional

(if + past perfect, ... would + have + past participle)

It talks about the past. It's used to describe a situation that didn't happen, and to imagine the result of this situation.

If she **had studied**, she **would have passed** the exam (but, really we know she didn't study and so she didn't pass)

If I **hadn't eaten** so much, I **wouldn't have felt** sick (but I did eat a lot, and so I did feel sick).

If we **had taken** a taxi, we **wouldn't have missed** the plane

She **wouldn't have been** tired if she **had gone** to bed earlier

She **would have become** a teacher if she **had gone** to university

He **would have been** on time for the interview if he **had left** the house at nine.

(Notice we can put 'if' at the beginning, or in the middle. It doesn't change the meaning. When 'if' is at the beginning of the sentence, we put a comma at the end of the 'if' clause. We don't use a comma when 'if' is in the middle of the sentence.)

## Grammar exercises

### Exercise 1. Translate the sentences.

1. If you want I will dictate the address to you. 2. If the entire ice cap of Greenland melts, the sea level will rise 7 m. Many researchers claim that if the temperature increases more than 3 C, such large sea level rises will be experienced. 3. If precipitation increases over land at high altitudes in the northern hemisphere, especially during the cold season, such extreme weather events will be expected to occur more frequently than previously. 4. If climate change causes loss of sea ice habitats, it will threaten the existence of polar bears and other ice-associated animals. 5. If the ice melting continues, the Barents Sea will probably be ice-free year round by 2050 with the detrimental consequences for the productive marginal ice flora and fauna. 6. This dam is old and crumbling and if it overflows, the industrial deposits it contains will poison drinking water for millions of people in Ukraine and Moldova. 7. If the environment is not protected from pollution, its damage will extract its cost from those living in the vicinity or others living at a distance or even from those coming generations.

**Exercise 2. Put the word in the brackets into the correct form.**

1. Before you (to cross) the park, you will come to a supermarket. 2. When you (to cross) the park, you will see the hospital. 3. If you (to translate) this article into Russian, I shall use it in my report. 4. If she (to be) in St. Petersburg now, she will meet you at the railway station. 5. If you (not to hurry), you will miss the train. 6. If it (to train), we shan't go to the country. 7. When my friend (to come) to Kiev, we shall go to the museum. 8. What will you be doing when he (to come) to your place? 9. Don't forget to play for your dinner before you (to leave) the canteen. 10. I shall be able to translate this article if you (to give) me a dictionary. 11. You will have to work hard at home if you (to miss) the lesson. 12. Where will you go when you (to come) to London? 13. The child won't be healthy if you (not to give) him much fruit. 14. I shan't have dinner before mother (to come) home. 15. What will you do if you (not to finish) your homework tonight? 16. What will he do if his TV set (to break)?

**Exercise 3. Put the word in the brackets into the correct form.**

1. If I (to stay) some more days in your town, I (to call) on you and we (to have) a good talk. 2. He (to go) to the Public Library very often when he (to be) a student. 3. As soon as I (to return) from school, I (to ring) you up. 3. You (to pass) many towns and villages on your way before you (to arrive) in Poltava. 4. I (to stay) at home till she (to come). Then we (to go) to the theatre if she (to bring) tickets. 5. After I (to finish) school, I (to enter) the University. 6. When he (to return) to Odesa, he (to call) on us. 7. If I (to see) him, I (to tell) him about their letter. 8. We (to gather) at our place when my brother (to come) back from Africa. 9. I (to sing) this song with you if you (to tell) me the words. 10. I hope you (to join) us when we (to gather) in our country house the next time. 11. What you (to do) when you (to come) home? 12. When they (to cross) the road, they (to see) the hotel. 13. Before she (to get) to the theatre, she (to go) past the shopping centre. 14. What we (to do) if it (to rain) tonight? 15. What she (to do) if she (to see) her best friend again? 16. If the bus (to be) very crowded, you (to be) exhausted by the time you (to get) to work. 17. If it (to be) very cold tonight, our car (not to start) in the morning.

**Exercise 4. Complete the Conditional Sentences (Type I) by putting the verbs into the correct form.**

1. If you (send) ... this letter now, she (receive) ... it tomorrow. 2. If I (do) ... this test, I (improve) ... my English. 3. If I (find) ... your ring, I (give) ... it back to you. 4. Peggy (go) ... shopping if she (have) ... time in the afternoon. 5. Simon (go) ... to London next week if he (get) ... a cheap flight. 6. If her boyfriend (phone / not) ... today, she (leave) ... him. 7. If they (study / not) ... harder, they (pass / not) ... the exam. 8. If it (rain) ... tomorrow, I (have to / not)

... water the plants. 9. You (be able/ not) ... to sleep if you (watch) ... this scary film. 10. Susan (can / move / not) ... into the new house if it (be / not) ... ready on time. 11. If you (eat) ... an ice-cream, I (have) ... a hot chocolate. 12. If she (need) ... a computer, her brother (give) ... her his computer. 13. If we (have / not) ... time this afternoon, we (meet) ... tomorrow. 14. He (talk) ... to her if you (want / not) ... to do it. 15. You (win / not) ... the game if you (know / not) ... the rules.

**Exercise 5. Translate the following sentences.**

1. If it snows, I will not go out. 2. If I find her address, I will send her an invitation. 3. If I don't see him this afternoon, I will phone him in the evening. 4. If John has the money, he will buy a new house. 5. If it rains, you will get wet. 6. You will get wet if it rains. 7. If Sally is late again I will be mad. 8. I will be mad if Sally is late again. 9. If you don't hurry, you will miss the bus. 10. You will miss the bus if you don't hurry. 11. If I have time, I'll finish that letter. 12. What will you do if you miss the plane? 13. Nobody will notice if you make a mistake. 14. If you drop that glass, it will break. 14. If you don't drop the gun, I'll shoot! 15. If you don't leave, I'll call the police. 16. If you drop that glass, it might break. 17. I may finish that letter if I have time. 18. If he calls you, you should go. 19. If I do my homework, I will be able to go to the park. 20. You will feel sick if you drink too much coffee.

**Exercise 6. Translate the sentences.**

1. Я подзвоню тобі, якщо буду мати час.
2. Якщо це плаття буде коштувати занадто дорого, я куплю інше.
3. Якщо у барі буде багато народу, ми підемо у інший.
4. Що ти будеш робити, якщо таксі не приїде?
5. Якщо він не зможе прийняти мене, я приїду іншим разом.
6. Вона запитав їх, чи побачить вона їх завтра.
7. Ти подзвониш мені, якщо будуть якісь проблеми?
8. Мама буде хвилюватись, якщо ти не прийдеш вчасно.
9. Якщо зима буде холодною, вони будуть кататися на ковзанах.
10. Він розлютується, якщо побачить вас тут.

**Exercise 7. Complete the Conditional Sentences (Type I) by putting the verbs into the correct form.**

1. If I (go) ... out tonight, I (go) ... to the cinema. 2. If you (get) ... back late, I (be) ... angry. 3. If we (not/see) ... each other tomorrow, we (see) ... each other next week. 4. If he (come) ..., I (be) ... surprised. 5. If we (wait) ... here, we (be) ... late. 6. If we (go) ... on holiday this summer, we (go) ..... to Spain.

7. If the weather (not/improve) ..., we (not/have) ... a picnic. 8. They (go) ... to the party if they (be) ... invited. 9. If I (not/go) ... to bed early, I (be) ... tired tomorrow. 10. If we (eat) ... all this cake, we (feel) ... sick. 11. She (stay) ... in London if she (get) ... a job. 12. If you (not/want) ... to go out, I (cook) ... dinner at home. 13. I (come) ... early, if you ... (want). 14. He (not/get) ... a better job if he (not/pass) ... that exam. 15. I (buy) ... a new dress if I (have) ... enough money. 16. She (cook) ... dinner if you (go) ... to the supermarket. 17. They (go) ... on holiday if they (have) ... time. 18) We (be) ... late if we (not/hurry) ... . 19. She (take) ... a taxi if it (rain) ... . 20. I (not/go) ... if you (not/come) ... with me.

**Exercise 8. Translate the following sentences.**

1. Якщо піде дощ, я залишуся у будинку мого друга. 2. Якщо я побачу Тома, я запитав у нього про Джона. 3. Якщо ти поцілуєш мене, я буду щасливим. 4. Якщо почую якісь новини про неї, подзвоню тобі. 5. Якщо ти загубиш гроші, я тобі допоможу. 6. Якщо погода гарна, я піду в парк. 7. Якщо перестане йти дощ, ми підемо прогулятися. 8. Якщо завтра буде дощ, ми не підемо в ліс. 9. Вона запізниться на автобус, якщо не вийде зараз. 10. Якщо я її зустріну, то розповім їй правду.

**Exercise 9. Suppose you are going on holiday to a foreign country. Make sentences according to the example.**

*Example: What will you do if you get food poisoning?  
I'll take medicine.*

1. lose your passport; go to embassy. 2. get sunburns; use a body lotion. 3. run out of money; go to the bank. 4. are homesick; phone my parents. 5. are mugged; go to the police station. 6. don't like the food; go for a meal to some different restaurant. 7. don't understand a language; use a dictionary. 8. don't get on with your friends; spend time by myself. 9. get lost; buy a map of the city. 10. miss the train; buy a ticket for the next one.

**Exercise 10. Translate the sentences into English.**

1. Він зробить вправу з англійської мови, якщо в нього не буде інших справ. 2. Якщо я не допоможу йому, він не напише контрольну роботу. 3. Він не піде до бібліотеки сьогодні ввечері. 4. Якщо він не піде до бібліотеки, він буде вдома. 5. Ми будемо вдома завтра. 6. Її не буде вдома завтра. 7. Якщо її не буде завтра вдома, залиште їй записку. 8. Коли вона прийде до школи, вона зніме пальто. 9. Я прийду додому о шостій годині. 10. Коли я прийду додому, я зателефоную вам. 11. Вона зателефонує нам

ввечері. 12. Я побачу Тома завтра. 13. Як тільки я побачу Тома, я розповім йому про це. 14. Завтра погода буде добра.

**Exercise 11. Translate the following sentences.**

1. If I lived in England, I wouldn't have any problems with my English. 2. If people trusted and respected each other, it would make life easier. 3. If I could read people's thoughts, it would be interesting to know all beforehand. 4. If you met her, you would fall in love with her at first sight. 5. If I were ill, I wouldn't eat anything. 6. If you went earlier, you would see her sister's husband. 7. If I had enough time, I would fly to San Francisco to visit my relatives. 8. If I were you I would study English much better. 9. What would you do if you won million pounds? 10. I don't really want to go to their party, but probably will go. They would be offended if I didn't do. 11. Kate has decided to apply for the job. She isn't really qualified for it, so she probably wouldn't get it if she applied. 12. I would be very frightened, if somebody pointed a gun at me. 13. If you took more exercises, you would probably feel healthier. 14. It's a pity you can't use computer. It would be useful if you could. 15. If Michael were here he would help you to find her adress.

**Exercise 12. Put the word in the brackets into the correct form.**

1. If I was offered the job, I think I (to take) it. 2. I'm sure Amy will lend you the money. I'd be very surprised if she (to refuse). 3. If I sold my car, I (not to get) much money for it. 4. A lot of people would be out of work if the factory (to close down). 5. What would happen if I (to press) that red button? 6. Would Tim mind if I (to use) his computer without asking him? 7. I'm sure Sue (to understand) if you explained the situation to her. 8. I (to help) you if I could, but I'm afraid I can't. 9. We would need a car if we (to live) in the country. 10. I wouldn't mind living in England if the weather (to be) better. 11. If he (to be) here now, ho could give you a good advice. 12. If I (to work) at this firm, I'd earn more. 13. If they (can) have some more lessons, they could improve their pronunciation. 14. If Emma (to know) the clue, our team would solve it. 15. If I offered them money, they (to stay) here?

**Exercise 13. Put the verb in the brackets into the correct form.**

1. If she (to find out) the truth, she (to be) very happy. 2. I (to visit) him in hospital, if I (to know) about his illness. 3. If we (to like) his suggestion, we (to tell) him about it. 4. If John (to want) the advice, he (to ask) you. 5. If his sister (to have) better qualification, she (to be able to) apply for better job. 6. They (to find) the solution, if they (to understand) the problem. 7. If Beth (to go) to her native town, she (to be) happier. 8. If you (not to agree) with me, I (to go) to the

director. 9. What you (to do), if he (to tell) you to leave? 10. If I (to be) you, I (to learn) English better. 11. If someone (to give) you a million, what you (to do)? 12. If she (to be) here now, she (to help) you. 13. If Sally (to have) spare time, she could pay you more attention. 15. If the train (to be) less crowded, we would be more comfortable. 16. If students (to be) attentive, they wouldn't make so much mistakes in their dictations.

**Exercise 14. Translate the sentences.**

1. I wish you were here. 2. I wish you had been here last week. 3. I wish you would be with me next summer. 4. I wish I had told you the truth. 5. Tom wishes Sue always had time for him. 6. Tom wishes Sue had had more time last week. 7. Tom wishes Sue would have more time in future. 8. I wish I could do it myself. 9. I wish I could have done it then. 10. I wish I would be able to do it soon.

**Exercise 15. Translate the sentences.**

1. Kate wished her boyfriend were more attentive to her. 2. Now she wishes she had agreed to marry him. 3. We wish it would rain. It's too hot. 4. I wish you wouldn't talk about that, Dad. 5. She wishes she were in love again. 6. I wish you would stop contradicting me! 7. We wished the police were more efficient and hadn't just turned everything upside down in the house. 8. Oh! I am so miserable! I wish I were dead! 9. I wish I could make him change his mind! I wish he would give up that silly idea. 10. Sometimes I wish I were thousands of miles away from civilization. 11. How I wish it were so for ages and nothing would ever change! 12. Many people wish life were not so hectic. 13. They wish you were less bossy and were not ordering people again. 14. How I wish I could fly in the blue sky, over the roofs, over this town! 15. What is love? – I wish I knew the answer. 16. I just wish I had your kind of spirit, Maggie.

**Exercise 16. Put the verb in the brackets into the correct form.**

1. I wish I (to know) French. 2. She fell and broke her leg. I wish she (to be) more careful. 3. I wish you (to read) more English books in future. 4. I feel sick, I wish I (not to eat) all the ice cream. 5. They need a singer for the choir. I wish I (can) sing. 6. My parrot has died. I wish I (to look after) it better. 7. I can't remember her telephone number. I wish I (can). 8. I wish I (not to lend) him my car: he has broken it. 9. My watch has stopped. I wish I (to have) a better watch. 10. I feel so tired. I wish I (not to stay up) so late last night. 11. My apartment is rather small. I wish I (to have) a bigger one. 12. I wish I (not to spend) all my money yesterday. 13. I wish I (to know) the answer to this question. 14. I wish you (to phone) me an hour ago. 15. I wish I (to know) then what I know now.

**Exercise 17. Translate the sentences using “I wish”.**

1. Якби в мене зараз був вільний час! 2. Шкода, що я запізнився на зустріч. 3. Якби я вмів малювати! 4. Шкода, що вона не знала відповіді на те запитання. 5. Було б добре, якби в мене зараз була відпустка. 6. Шкода, що я не послухався їх поради. 7. Шкода, що вони не змінили свою думку. 8. Було би добре, якби ти знав правду. 9. Якби ти сказав мені про це рішення! 10. Шкода, що він не припинив робити такі помилки. 11. Шкода, що вона хворіє. 12. Шкода, що вже пізно йти на збори. 13. Вона шкодувала, що припинила там працювати. 14. Якби він вмів плавати! 15. Було би добре, якби ви взяли участь в обговоренні цього проекту. 16. Шкода, що ти не застав мене вдома. 17. Шкода, що дитина не цікавиться історією. 18. Шкода, що ви провели літо в селі. 19. Шкода, що він не в Одесі. 20. Я би хотів згадати її адресу. 21. Шкода, що вона не любить класичну музику. 22. Мені шкода, що не відвідав цю виставку.

**Exercise 18. Work in pairs. Discuss what would happen if the situations were different:**

*Example: I don't live on the Bahamas. - I wish I lived on the Bahamas.*

*I didn't live on the Bahamas then. - I wish I had lived on the Bahamas then*

1. I didn't have enough time to learn English well. 2. He hated having music classes when a child 3. Eve failed to find a better job. 4. Helen didn't learn English well so she is doing it now. 5. Ann watches TV too much. Her mother wants to stop it. 6. Kate can't stop having too much coffee. 7. Linda does not have a lot of money. 8. Mike is too old to start a new business. 9. David does not understand his parents. 10. Jack did not make much money last year.

**Exercise 19. Translate the following sentences:**

1. They would have been surprised if I had made such a mistake.
2. If you had put on your glasses, you would have seen better.
3. Would you have been angry if we hadn't come?
4. If I had met, you yesterday I would have helped you.
5. If they had gone to the library, they would have prepared for the seminar.
6. If she had heard about it yesterday she would have been pleased.
7. He would have found all about this discovery if he had translated the article yesterday.
8. If we had seen them earlier, we would have asked them to come to our place.
9. If you had rung him up yesterday, you would have known about his illness.
10. I would have caught a lot of fish if I had joined you in fishing.

**Exercise 20. Put the words in the brackets into the correct form.**

1. He would't have been so upset if Susan (to write) to him earlier.
2. If he (to know) that Chinese was going to be so difficult, he would never have started to learn it.
3. If father (to manage) to repair his car, he could have driven us to Kiev.
4. If they (not to reach) the land, the sailors would have died.
5. We would have taken her for barbecue if she (to ask) us.
6. If he (to ask) politely, they might have helped him.
7. If she (not to hear) the news, she would't have gone there.
8. If the factory (not to cut back) production, many people would have lost their work.
9. What would they have done if we (not to help) then?
10. He might have heard about it, if he (not to turn on) the radio.
11. If you (to ask) her for tickets, she could have given you some.
12. If they (not to come) home, they wouldn't have noticed the fire.
13. If I (not to be) in a shower, I would answer the call.
14. We wouldn't have gone to this party if we (to know) the truth.

**Exercise 21. Put the words in the brackets into the correct form.**

1. If the weather (to be) fine, we (to play) outside.
2. If you (to ring) me up, I (to tell) you something.
3. If my friend (to come) to see me, I (to be) very glad.
4. If mother (to buy) a cake, we (to have) a very nice tea party.
5. If we (to receive) a telegram from him, we (not to worry).
6. If you (not to work) systematically, you (to fail) the examination.
7. If I (to get) a ticket, I (to go) to the theatre.
8. If my husband (to return) earlier, we (to watch) TV together.
9. If she (to know) English, she (to try) to enter the university.
10. If you (to be) busy, we (to meet).
11. The London Fire never (to start) if the baker (to put) his oven out properly.

**Exercise 22. Translate the following sentences.**

1. If it had rained, you would have gotten wet. 2. You would have passed your exam if you had worked harder. 3. I would have believed you if you hadn't lied to me before. 4. If you hadn't lied to me before, I would have believed you. 5. If I had worked harder I would have passed the exam. 6. If I had known you were coming I would have baked a cake. 7. I would have been happy if you had called me on my birthday. 8. If you'd given me your e-mail, I'd have written to you. 9. I would have bought you a present if I had known it was your birthday. 10. If I had found her address, I would have sent her an invitation.

**Exercise 23. Complete the Conditional Sentences (Type III) by putting the verbs into the correct form.**

1. If the weather (to be) ... nice, they (to play) ... football.
2. If we (to go) ... to a good restaurant, we (to have) ... a better dinner.
3. If John (to learn) ... more words, he (to write) ... a good report.
4. If the boys (to take) ... the bus to school, they (to arrive) ... on time.
5. If the teacher (to explain) .... the homework, I (to do) ... it.
6. If they (to wait) ... for another 10 minutes, they (to see) ... the pop star.
7. If the police (to come) .... earlier, they (to arrest) ... the burglar.
8. If you (to buy) ... fresh green vegetable, your salad (to taste) ... better.
9. If Alex (to ask) ... me, I (to email) ... the documents.
10. If he (to speak) ... more slowly, Peggy (to understand) ... him.

**Exercise 24. Complete the Conditional Sentences (*First, Second та Third Conditionals*) by putting the verbs into the correct form. Translate the sentences.**

1. If she (to find out) the truth, she (to be) very happy.
2. I (to visit) him in the hospital, if I (to know) about his illness.
3. If we (not to like) his suggestion, we (to tell) him about it.
4. If John (to want) the advice, he (to ask) you.
5. If his sister (to have) better qualification, she (to be able to) apply for better job.
6. They (to find) the solution, if they (to understand) the problem.
7. If Beth (to go) to her native town, she (to be) happier.
8. If you (not to agree) with me, I (to go) to the director.
9. What you (to do), if he (to tell) you to leave?

**Exercise 25. Translate the following sentences.**

1. Ви би почували себе краще, якби ви лягли спати раніше.
2. Він би краще знав англійську, якби влітку прочитав англійські книги.
3. Якби вони прийшли раніше, вони б змогли зайняти найкращі місця.
4. Ми би не запізнилися на потяг, якщо б взяли таксі.
5. Якщо піде дощ, діти залишаться вдома.
6. Якби учора не було так холодно, ми б поїхали за місто.
7. Якщо ти добре попросиш брата, він відремонтує твій велосипед.
8. Якщо він вивчить німецьку мову, він поїде вчитися до Німеччини.
9. Якби ми отримали телеграму, ми б вас зустріли.
10. Якби не було так слизько, вона б не впала.
11. Він би давно вже добрався до міста, якби не заблуdivся.
12. Сад давав би гарний врожай, якби за ним доглядали.
13. Він би зараз не сидів за кермом, якби водій не взяв вихідний.
14. Шкода, що цей автор не вразив її.
15. На жаль, справи завадили йому взяти участь у експедиції.

16. Якби він з'явився тут, вона б одразу пішла геть.
17. Якби він не зробив зауваження, вона б ще й досі виступала.
18. Подорож була б гарною, якби не потрібно було робити пересадку.
19. Якби він не був занудою, то не набрид би усім.
20. Якби книжка була новою, вона б коштувала набагато більше.
21. Йому хотілося самому заробляти на життя.
22. Хотілося б, щоб уже розвиднилося.
23. Він би не вчився зараз керувати автомобілем, якби не купив його минулого тижня.
24. Якби він був підготовлений, то здав би іспит.
25. Він буде відрахований, якщо і далі пропускатиме заняття.
26. Він би не програв змагання, якби був у належній формі.
27. Якби він не складав іспити зараз, вони б могли бачитися частіше.
28. Якби вони не об'їхали всю Європу, їм би не заздрили так.
29. Шкода, що вони не мають мобільних телефонів.
30. На жаль, поїздка не принесла їм ніякої користі.
21. Він шкодує, що не буде на роботі кілька днів.
31. Якби вони не були друзями, то побилися б.
32. Якщо вони потраплять сюди, то будуть зачаровані природою.
33. Якщо його покарають, він дуже засмутиться.
34. Якщо вона поскаржиться, скажіть, що вона сама винна.

**Exercise 26. Translate the sentences into Ukrainian. Mind that meaning is not past.**

1. What would you do if you won a million pounds? 2. I don't really want to go to their party, but I probably will go. They will be offended if I don't go. 3. Kate has decided to apply for the job. She isn't really qualified for it, so she probably wouldn't get it if she applied. 4. I would be very frightened if somebody pointed a gun at me. 5. If you took more exercise, you would probably feel healthier.

**Exercise 27. Translate the following sentences.**

1. Він пошкодував, що прийшов без запрошення. 2. Якби вони не галасували, вона б не розгнівалася. 3. Якби вони зателефонували до поліції, над ними б лише посміялися. 4. Вона відчула б полегшення, якби все з'ясувалося. 5. Якщо словники не викуплять, вони будуть продані. 6. Шкода, що життя роз'єднало нас. 7. На жаль, вона йому не сестра. 8. Якби ви знали матеріал, то відразу б здали іспит. 9. Якщо їй не вдасться здати іспит, потрібно буде працювати додатково. 10. Якби він не був такий розумний, то не досяг би такого успіху. 11. Якщо ти знову загубиш ручку, бери мою. 12. Хотілося б гарно грати в теніс. 13. Шкода, що зараз не можна полювати. 14. Вони пожалкували, що залишили його вдома самого. 15. Якщо він не буде слухати записи, йому буде важко поставити вимову.

16. Якщо вона нікого не бажає бачити, то так і каже. 17. Якби ці операції робилися руками, це потребувало б набагато більше часу. 18. Він допоможе їй за умови, що вона більше не буде запізнюватися. 19. Якби її щось не влаштовувало, вона б одразу сказала про це. 20. Вона б не одужала так швидко, якби про неї так не піклувалися. 21. Якщо пливти вниз за течією, можна дістатися моря. 22. Якщо бажаєте одержувати більш високу зарплатню, слід краще працювати. 23. Вона пожалкувала, що не пообідала. 24. Хотілося б, аби йому було стільки ж років, як і їй. 25. Якби вона бачила, що вони були проти, то не наполягала б.

**Exercise 28. Work in pairs. Discuss what would happen if the situations were different.**

*Example: Ken didn't earn enough money last year. He can't buy a motorcycle now.  
If Ken had earned enough money last year, he would buy a motorcycle now.*

1. John was not a student then. He doesn't have a degree now. 2. Diana failed to win lottery then. She can't buy a house now. 3. Eve refused to marry John then. She is not his wife now. 4. Helen didn't work enough at her English then. She can't get a good job now. 5. Ann used to ignore all young men then. She is not married now. 6. Kate did not to go to Paris then. She can't tell anything about the city now. 7. Linda did not leave her job then. She can't get a new job now. 8. Mike and Barbara were close friends then. They are married now. 9. Morris could not find out David Beckham's phone number then. He doesn't have his autograph now. 10. Jack was not very clever then. He has serious problems now.

**Exercise 29. Translate the following sentences.**

1. Було б краще, якби він купив щось приємніше. 2. Вона б допомогла, якби він попросив. 3. Якби вона не соромилася, то й сама б зателефонувала. 4. Вона зачекала б на нас, якби не була така заклопотана. 5. Якби вона мала більше часу, вона б вивчала французьку. 6. Він би зміг закінчити роботу, якби знав, що робити. 7. Якби він і прийшов, то нікого б не знайшов. 8. Якби його запитали, він би порадив залишитися вдома. 9. Якби вона була дорослою, то робила б усе, що забажає. 10. Якби він був поетом, то присвятив би їй поему. 11. Вона б також купила словника, якби знайшла його. 12. Вона б поїхала, якби не було так холодно. 13. Вона б купила мікрохвильову піч, якби мала гроші. 14. Він би поїхав на море, якби мав відпустку влітку. 15. На вашому місці, вона б поїхала туди. 16. Якби вона зустріла його, то не впізнала б. 17. Вона б не почала обговорювати це, якби їй не доручили. 18. Якби авто не було таким старим, вони б поїхали на ньому у відпустку. 19. На твоєму місці, вона б розповіла про все. 20. Якби він її запросив, вона б не відмовилася. 21. Якби вона мала гроші, то об'їхала б увесь світ. 22. Якби це трапилося з нею, вона б засмутилася. 23. Вона б зраділа, якби це було правдою. 24. Якби він звернувся за

допомогою, вона б не змогла йому відмовити. 25. Якби він знав, що робити, то не звертався б за порадою.

**Exercise 30. Work in pairs. Discuss what would happen if the situations were different.**

*Example: I didn't have a million dollars. I couldn't buy an island.*

*If I had had a million dollars then, I would have bought an island.*

1. John's video was broken. He failed to record the Super Bowl game. 2. The play was good because Diana Hightower played the leading part. 3. Eve was there. That's why John did not leave. 4. Helen didn't marry David. That's why she did not emigrate. 5. Ann did not become an opera singer. That's why she was very unhappy then. 6. Kate was not a skilled dancer. That's why she was very shy. 7. Linda did not know about Andrew's problems. That's why she did not help him at once. 8. Mike managed to buy a house because his bank gave him a loan. 9. Morris met his wife-to-be at the New-Year party. He went there by chance. 10. Jack was a success because he invested his money well.

**Exercise 31. Translate the following sentences into English.**

1. Якби наш бухгалтер не помилився вчора, то закінчив би розрахунки сьогодні. 2. Якби він зателефонував учора, вона б зараз не турбувалася. 3. Якби вчора був вихідний день, вона б не була такою втомленою сьогодні. 4. Якби вчора пройшов дощ, зараз не треба було б поливати город. 5. Якби він повторив домашнє завдання перед заняттям, то тепер не чекав би підказки. 6. Якби він раніше пішов спати, у нього б не боліла зараз голова. 7. Якби він не почув про це по радіо учора, то сьогодні прочитав би про це в газеті. 8. Якби замок не зламався, вони б тепер пили чай. 9. Якби вона прийшла учора, ми могли б усі разом поїхати за місто сьогодні. 10. Якби ти послухав мою пораду, мені б не потрібно було зараз викликати слюсаря. 11. Якби він учора надягнув плаща, у нього б тепер не боліло горло. 12. Якби вона закінчила переклад учора, їй би зараз дозволили прогулятися. 13. Якби вона мала сумнів щодо його чесності, вона б тепер розмовляла з ним інакше. 14. Якби їх познайомили раніше, їм було б легше зараз знайти спільну мову. 15. Якби їй позичили учора трохи грошей, вона б сьогодні їх уже повернула. 16. Коли б вони з'їздили влітку на південь, то не говорили б про це так часто тепер. 17. Якби вона пояснила все вчора, він би не розпитував про це зараз. 18. Якби їм вдалося дістати квитки вчора, вони б тепер ніжилися на сонечку. 19. Якби йому в дитинстві читали казки, він би зараз вірив у дива. 20. Якби він не зламав ногу, вони б сьогодні пішли на прогулянку. 21. Якби вони написали диктант учора, сьогодні вона б його перевіряла.

### Test 1 Choose the correct variant:

1. If I knew his address, I ... him.  
a) visited                      b) would visit                      c) had visited
2. If Sue ... anybody the news, it won't be a secret.  
a) tells                      b) had told                      c) told
3. If Tom ... the bus, he would have come to the meeting on time.  
a) hasn't missed                      b) missed                      c) hadn't missed
4. If I see Jill, I ... her to call you.  
a) would remind                      b) will remind                      c) has reminded
5. If I were you, I ... the red dress.  
a) had chosen                      b) would choose                      c) choose
6. If she had been taking care of her health, she ... ill.  
a) wouldn't have fell                      b) didn't fall                      c) wouldn't have fallen
7. We will stay at this hotel provided it ... much.  
a) doesn't cost                      b) didn't cost                      c) hadn't cost
8. If Mark ... for the job, he would have got it.  
a) applies                      b) will apply                      c) had applied
9. If it were not for the snow, we ... a car to the cinema.  
a) can drive                      b) could drive                      c) could drove
10. If he had phoned me, I ... him the home task.  
a) would have told                      b) would tell                      c) told

### Test 2 Choose the correct variant:

1. They'll go to the restaurant if they ... a table in advance.  
a) would reserve                      b) reserve                      c) reserved
2. If I found a purse, I ... it back to the owner.  
a) would give                      b) had given                      c) will give
3. If Mark ... so much, he would be fit.  
a) didn't ate                      b) won't eat                      c) didn't eat
4. If he hadn't asked for the directions, we ... lost.  
a) might has got                      b) might have got                      c) may got
5. We'll miss you a lot in case you ... to another house.  
a) will move                      b) would move                      c) move
6. I wish I ... in the countryside. (but I don't)  
a) lived                      b) live                      c) would live
7. I won't believe you unless you ... clear evidence.  
a) give                      b) will give                      c) had given
8. We would have been injured in the crash if we ... seatbelts.  
a) hasn't been wearing                      b) hadn't been wearing                      c) wore
9. If you hadn't left your camera at home, we ... lots of pictures.  
a) could took                      b) took                      c) could have taken
10. If John ... the local race, he will take part in the national championship.  
a) won                      b) wins                      c) would win

### Test 3 Choose the correct variant:

1. If the temperature falls below 0 °C, water ... into ice.  
a) turned b) turns c) will turn d) turn
2. If he ... the fine, he will go to the prison.  
a) hadn't paid b) won't pay c) doesn't pay d) wouldn't pay
3. If I ... time, I'd take up sport.  
a) have b) had had c) had d) am having
4. If she had studied harder, she ... the test.  
a) would have passed b) would pass c) would passed d) passed
5. If you need help, ... to me.  
a) will come b) would come c) comes d) come
6. If I hadn't been rude to her, she ... upset now.  
a) would not have been b) wouldn't be c) will not be d) isn't
7. If I were you, I ... to your mother.  
a) would listen b) had listened c) will listen d) listen
8. If you ... your work, we can have a rest.  
a) will finish b) finished c) had finished d) have finished
9. If you add sugar to a cup of tea, it ... sweeter.  
a) taste b) tasted c) tastes d) will taste
10. If he hadn't been acting so foolishly, he ... punished.  
a) would be b) wouldn't have been c) would have not be d) would be not

### Test 4 Choose the correct variant:

1. If you ... ever in our town, you should come and visit us.  
a) will be b) were c) are d) be
2. If he had found a job, he ..., for money now.  
a) won't ask b) would not have asked c) had not been asking d) wouldn't ask
3. If I ... a lottery, I ... a yacht.  
a) win / would buy b) has won / would buy c) win / would have bought d) won / would buy
4. If the weather ... tomorrow, we'll go for a walk.  
a) will be fine b) is fine c) was fine d) fine
5. If I ... earlier, I wouldn't be late now.  
a) got up b) had got up c) were got up d) did get up
6. If I ... in a bigger house, I would invite a lot of friends to my party.  
a) lived b) had lived c) live d) had been living
7. If I do my homework, the teacher ... happy.  
a) is b) will be c) were d) was
8. If you heat water up to 100 °C, it ... .  
a) will boil b) boiled c) boils d) had boiled
9. If he had had money, he ... her a gift.  
a) will buy b) would buy c) would have bought d) would not have bought
10. Emma ... a card if she had remembered it was their anniversary.  
a) would have sent b) would sent c) sends d) sent

### Test 5 Choose the correct variant:

1. If Naomi Campbell hadn't been so beautiful, she ... a supermodel.  
a) will not become   b) would not have become   c) would not become  
d) would become
2. If I ... work late, I will call you.  
a) have to   b) would have to   c) will have to   d) had to
3. If I were you, I ... to your sister.  
a) had talked   b) would talked   c) would talk   d) talked
4. If you ... that plate, you'll burn your fingers.  
a) will touch   b) touch   c) touched   d) had touched
5. If I ... the bus, I wouldn't have been late for my job interview.  
a) didn't miss   b) would not missed   c) would not have missed   d) hadn't missed
6. They would have helped us if we ... them.  
a) had asked   b) hadn't asked   c) would asked   d) asked
7. She will join us later unless she ... a lot of work to do.  
a) isn't have   b) won't have   c) doesn't have   d) has
8. If nobody paid the bill, the electricity ....  
a) will cut off   b) will be cut off   c) would cut off   d) would had been cut off
9. If he knew her, he ... to her.  
a) would spoke   b) will speak   c) spoke   d) would have spoken
10. ... you don't leave the home now; you'll miss the bus.  
a) If   b) Whether   c) Unless   d) Supposing

## LESSON V

### Text

Exercise 1. Translate the text using a list of unknown words.

### Diversity and Distribution of Molluscs in the Intertidal Zone of Nglambor Beach, Gunung Kidul, Yogyakarta

Yunita Fera Rahmawati\*, Rizka Apriani Putri, Tatag Bagus Putra Prakarsa, Milade Annisa Muflihaini and Yoga Putra Aliyani

Department of Biology Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Yogyakarta. Jl. Colombo No. 1 Karang Malang, Yogyakarta. Tel.: +62 -586168

\* Correspondence author: [yunita.fr@uny.ac.id](mailto:yunita.fr@uny.ac.id)

### Abstract

The intertidal zone is the area between the highest and lowest tides, which represents the transition from ocean conditions to land conditions. This study aimed to determine the diversity and distribution of mollusks that exist along the intertidal zone of Nglambor Beach, between August and November 2020. Observations of all molluscs were carried out at two random stations using 10 plots measuring  $1 \times 1 \text{ m}^2$  with 5 meters. A total of two classes of Mollusca (Gastropod and Bivalvia) belonging to twelve families and 19 species were found from upper to lower an intertidal zone. The upper intertidal zone was recorded to have the highest diversity and an evenness index (Shannon-Wiener diversity index:  $H' = 2.524$  and Pielou evenness index:  $J' = 0.932$ ) compared to the middle and lower zones. It can be concluding that the diversity index in the study location is categorized as medium and its evenness is high. *Thais hippocastanum* is the most dominant species found in the upper and middle zones, while *Thais tissoti* dominates in the lower zone. This research contributed to a preliminary checklist on molluscs, which will support a baseline study on the intertidal in future.

**Key words:** Intertidal Zone / Molluscs / Diversity / Evenness / Nglambor Beach  
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### 1 Introduction

The intertidal region, a zone of interaction between sea, land, and atmosphere, is one of the most interesting divisions of marine ecosystem, as it is daily covered and uncovered by flooding and ebbing tides. Organisms found on rocky shores are facing intense physicochemical conditions during tidal changes from upper to lower intertidal zones. This includes regular exposure to air during low tide as well as differences in environmental parameters such as temperature, salinity, pH, and oxygen that occur perpendicular to the shore. Despite these challenges,

resilient and resistant organisms such as algae, lichens, barnacles, and molluscs are commonly found in such environments.

Nglambor Beach is one of the rocky beaches in the south of Gunungkidul Yogyakarta. This beach is in Purwodadi Village, Tepus district. The main character of this beach is that it has a basic material in the form of sandy coral with sand that is more dominant than the type of coral. Additionally, there is a kind of karst rock (limestone) that adorns the underwater. The physical condition of this beach has steep cliffs, karst hills and white sand. Nglambor beach has waves that are not too high due to the giant hill that looks like a turtle as a breakwater.

The intertidal zone on the Nglambor beach is divided into three subzones which are regulated by different biological and physical factors, namely the upper, middle, and lower zones. During the highest, all three sub intertidal zones are submerged, and the tidal zone is only seen during the lowest tide [7]. Some substrate types in the intertidal area on Nglambor beach are sandy and some are rocky. Organisms found on rocky shores face intense physicochemical conditions during tidal changes from upper to lower intertidal zones, such as temperature, salinity, pH, and oxygen which occur perpendicular to the coast.

Molluscs are one of many organisms found on this beach, animals that can bury themselves and tend to have slippery and heavy shells. Molluscs are the second largest phylum after Arthropods (insects) with an estimated 80,000-100,000 species identified [9, 10]. These animals have soft bodied features, which are housed by a single, calcareous shell that varies in size, shape, and colour. Molluscs have important roles in coastal ecosystem food webs, algae feeders, detritivores, and deposit feeders [1, 2, 3]. Abundance and intertidal biota were reported from the south coast of Gunungkidul by [11 - 16]. The processes in an ecosystem can take on the diversity of the organisms that make it up. Measuring species richness and diversity across different habitats are a useful tool for planning actions to conserve marine biodiversity [8, 17, 19, 20]. Therefore, this study explains the species composition, diversity and evenness of molluscs and compares them in three, intertidal zones, upper, middle, and lower. The results of this study are expected to enrich the data on the species and habitat of invertebrates in Yogyakarta, Indonesia. The study aims to determine the diversity and distribution of molluscs that exist along the intertidal zone.

## **2 Materials and Methods**

### **2.1 Study sites**

The sampling was carried out in August 2020 and November 2020 at the low tide. The intertidal area was divided into three zones: upper, middle and lower intertidal beaches. The research was located at 8°10'55"S and 110°40'44"E. Nglambor beach located in Tepus, Gunungkidul Regency, Indonesia. Abiotic

data sampling was done by measuring physical and chemical factors including substrate, temperature, pH, and salinity.

## **2.2 Procedures**

### **2.2.1 Sample collections**

This study used a systematic plot transect method by placing a 1x1 m<sup>2</sup> plot systematically along the transect. The implementation technique was to determine the main axis (SU) parallel to the coastline with a distance between the main axis and the coastline was 10 meters. Then 2 stations observation randomly had to be determined, afterwards the plots with 5 m each we relayed. In each plot, observations were made of all molluscs, including those at the bottom of the substrate. For animals embedded in the substrate, a dig to a depth of 5-10 cm was performed.

Collecting data for molluscs were carried out directly at the research location, namely recording species, morphological characteristics some species in each plot, after collecting photos, photos of the specimens were collected. Finally, the sample was placed into a plastic jar that already contains 70% alcohol soaked until all parts of the body of the sample were immersed.

### **2.2.2 Colour illustrations**

The molluscs were brush cleaned and washed with tap water to remove layers of algae, another crust, and dirt. The identification of molluscs based on morphological characteristics in the form of shape, colour, and shell characteristics. Molluscs are identified to the lowest possible taxonomic level using key taxonomic identifications [16, 21-27]. The validity of species names was also reviewed from the World Register of Marine Species (WoRMS) a database.

## **2.3 Data Analysis**

The density of marine gastropods was determined as a few individuals/m<sup>2</sup>. The diversity was calculated using the Shannon-Wiener index.

Shannon-Wiener index formula is:

$$H' = - \sum P_i \ln P_i$$

In the above,  $H'$  is the value of the Shannon-Wiener diversity index,  $P_i$  is the proportion of the  $i^{\text{th}}$  species ( $n_i/N$ ),  $n_i$  is the number of individuals of the  $i^{\text{th}}$  species,  $N$  = the total number of individuals of all types. The Shannon-Wiener diversity index is classified into three levels: low ( $H' < 2$ ); moderate ( $2 < H' < 4$ ); and high ( $H' > 4$ ) [28].

The species evenness index was calculated using Pielou's evenness index.

Pielou's evenness index formula is:

$$J' = H' / H'_{\max}$$

In the above equation,  $H'$  is the Shannon-Wiener diversity index and  $H'_{max}$  is the natural logarithm of species richness. Species evenness ranges from zero to one, with zero signifying no evenness, and one a complete evenness.

Frequency of incidence (FoI) was estimated using the below equation.

Frequency of incidence formula is:

$$FoI = Ni.St / N.St \times 100\%$$

In the above equation,  $Ni.St$  is the total number of locations where the species  $I$  was found and  $N.St$  is the total number of sampling locations [29].

### 3 Result

A total of two class of molluscs (Gastropod and Bivalvia), belonging to thirteen families and 20 species, were found in upper to lower intertidal zone at Nglambor Beach (Table 1 and Figure 1).

In this study 15 Gastropod and 4 Bivalvia species were revealed. The Molluscs species referred to in Table 1. *Thais hippocastanum* (Muricidae) was the most abundant species in the upper and lower intertidal zones, while *T. tissoti* (Muricidae) was the most abundant in the middle zone. More commonly known as a murex or rock snails, Muricidae are reported to be widely distributed inhabiting coastal and marine habitats. Most of the Muricidae are seen clustered between rock crevices. This behaviour is to ensure water and a humidity conservation during the dry season at a low tide. This can prevent damage to marine gastropoda systems, such as respiration, excretion, and digestion. Such characteristics help the Muricidae to be resilient in extreme ecosystems.

In general, higher FoI gastropods were found mostly at all sampling locations, compared to the number of Bivalves (Table 1). Based on the sampling station, it was found that station II had the highest species richness compared to Station I. Station II was the location that received a direct sea water flow. The flow of sea water was observed from west to east and periodically reverses a direction. The water flow that occurs causes the water in the area to come directly from ocean currents, so there are far more species inhabiting the area in contrast to station I.

The species that have the lowest abundance in the upper intertidal zone were *Conus biliosus* (Conidae), in the middle zone *Aplysia dactylomela* (Aplysiidae) and *Monetaria annulus* (Cypraeidae). In the lower zone it was *Thais distinguenda* (Muricidae) (Figure 1). We expect that some of these species have a difficulty adapting to extreme environmental conditions, such as the disturbance by physical and biological parameters as well as to predation, competition, the light intensity, and hydrodynamics.

The index of Shannon-Wiener diversity for molluscs ranged from 1.925 - 2.524, where the highest diversity is in the upper zone and low diversity was in the lower zone. In general, the average diversity of molluscs was 2.254 which indicates a moderate category. The evenness index of the species ranged from 0.876 - 0.932 with an average value of 0.895 and showed high evenness (Table 2). The number of individuals affects the evenness because these species can be found in large numbers at each station. *T. hippocastanum*, *T. tissoti* and *Conus coronatus* were the predominant species found in the high abundance upper, middle, and lower zones. The diversity index in the moderate category shows a good balance between the number of species, and the total individuals of each species. Meanwhile, the high evenness index of molluscs found in the research location indicates that the distribution of individuals in each species is evenly distributed in a community and no species dominated.

In general, molluscs are detritus feeders, they grow well in substrates with high organic matter. According to [35] the abundance of molluscs depends on the availability of foods, such as detritus and macro algae, and they prefer habitats that are protected from currents, waves, and direct sunlight [34, 36, 37]. In addition, the abundance of molluscs at the research location was supported when data collection was carried out during the rainy season, where the input of organic matter increased, and the area of organic bodies increased, and the area of water bodies increased, among others by the formation of flood plains, so most of the members reproduced. This research contributed to enhanced knowledge in marine biodiversity. The benefit of this knowledge is contributes to a preliminary checklist on molluscs, which will support a baseline study on the intertidal in future.

Based on ecological parameters (Table 3), station 1 which is on the west side has the highest PH. Environmental bases that appear at station 1 are rock cliffs formed from coral. Rocks that contain calcium carbonate ( $\text{CaCO}_3$ ) can increase the pH of the water in the area by more than 7. Station 4 is a location that gets direct seawater flow. Seawater flow is observed from west to east periodically reverses direction. The water that occurs causes the water in the area to come directly from the ocean currents. The water temperatures at each research location has variations. Temperature variations at each research station are closely related to sunlight. At station 1 some cliffs can interfere with sunlight reaching the water maximally compared to other research stations so that the temperature is lower.

#### **4 Discussion**

This research found 15 species from the class Gastropods and 4 species from the class Bivalvia in the upper, middle, and lower intertidal zones. In the class Gastropods, the following species were found: *Aplysia dactylomela*, *Conus*

*bilius*, *Conus coronatus*, *Cypraea annulus*, *Cypraea carneola*, *Monetaria annulus*, *Mitra litterata*, *Thais distinguenda*, *Thais hippocastanum*, *Thais tissoti*, *Thais turbinidae*, *Nerita incerta*, *Nerita signatus*, *Trochus radiatus* dan *Turbo bruneus*. Meanwhile, in the Bivalvia class, *Barbatia reeveana*, *Isonogmon bicolor*, *Modiolus philippinarum*, and *Pecten sp.* *Thais hippocastanum* (Muricidae) is the most dominant species found in the upper and middle zones, while *Thais tissoti* (Muricidae) dominates in the lower zone. Muricidae were found in all zones with high diversity. This may be related to shell morphology and sculptural patterns [38, 39]. Muricidae such as *Thais hippocastanum* and *Thais tissoti* have slender shells and high spires which can help them minimize the effects of strong waves during high tide and water loss during high tides low tide. While the species found in small numbers were *Conus bilius* in high tide, *Aplysia dactylomela*, and *Monetaria annulus* in middle tide, and *Pecten sp.* in low tide. This is related to the availability of food sources and supportive environmental conditions. Bivalvia generally prefer substrate muddy, sandy, or a mixture of both [40].

The identified mollusc species, especially the Gastropod group, exhibit unique behaviour. They can move fast enough to hide into rock or rock holes to protect themselves from strong waves at high tide, while at low tide the animals come out of hiding to find food. This dynamic behaviour becomes a routine activity to maintain its survival and adapt to natural conditions or the environment. In addition, several types of molluscs were found in a dead state, which was only in the form of shells scattered along the coast. Mollusc's species are affected by movement patterns and levels of exposure to wave action and the difference in their density on the Nglambor beach may be due to adaptation to water parameters and biological factors such as food distribution in the area [41].

The diversity index can show the balance of the aquatic environment which is characterized by the emergence of certain species that are more dominant over other species in the community so that in an unbalanced aquatic environment, the diversity index will be low, especially if there are only one species that dominates and has the percentage of the number exceeds 50% of the total species that exist [42].

The upper intertidal zone was recorded to have the highest diversity and an evenness index (Shannon-Wiener a diversity index:  $H' = 2.524$  and Pielou evenness index:  $J' = 0.932$ ) compared to the middle and lower zones. It can be concluded that the diversity index in the study location is categorized as moderate and its evenness is high. A community is said to have high diversity if there is no competition between species, there is sufficient food availability, and supportive environmental conditions. [42] Soegianto (1994) states that a community is said to have high species diversity if the community is composed of many species (species) with the same or almost the same species abundance.

The same thing was stated by [43] Odum (1996) that species that have high species diversity shows that these species can occupy a wider space so that there are more opportunities to breed.

In addition, environmental factors such as the level of exposure to wave action, duration of exposure and immersion by seawater, and sea temperature may affect the value of mollusc's diversity in the study area [41]. The presence or absence of competitors, predators, and food sources is also expected to affect species diversity in the area. All specimens found in the transect plot were identified, counted, and recorded in the field, except for unidentified specimens, collected, put in a plastic jar containing 70% alcohol, and brought to the Zoological Laboratory of Yogyakarta State University for further identification. Gastropods and bivalves were identified for the key following species level by [21-27, 29]. Valid gastropod and Bivalvia names are referred to the World Register of Marine Species (WoRMS). Density is determined as some individuals/m<sup>2</sup>. Shannon Wiener and Pielou's indices were used to analyse the species diversity and evenness of their respective animal communities [44].

This study is the first attempt at surveying molluscs on the intertidal rocky coast of Nglambor Beach. Although it is preliminary, it could provide a baseline study on the occurrence and distribution of molluscs in this area. This study contributes to a complete checklist on molluscs of the south coast of Yogyakarta.

## 5 Conclusion

A total of two classes of molluscs (Gastropoda and Bivalvia) belonging to 12 families and 19 species were found from upper to lower an intertidal zone. The upper intertidal zone was recorded to have the highest diversity and an evenness index (Shannon-Wiener a diversity index:  $H' = 2.524$  and Pielou evenness index:  $J' = 0.932$ ) compared to the middle and lower zones. It can be concluded that the diversity index in the study location is categorized as moderate and its evenness is high. *Thais hippocastanum* (Muricidae) is the most dominant species found in the upper and middle zones, while *T. tissoti* (Muricidae) dominates in the lower zone.

This study is the first attempt of surveying molluscs on the intertidal rocky coast of Nglambor Beach. Although it is preliminary, it could provide a baseline study on the occurrence and distribution of molluscs in this area. This study contributes to a complete checklist on molluscs of the south coast of Yogyakarta.

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**Exercise 2. Translate and study the following words and expressions:**

Post hoc, the intertidal zone, diversity, distribution, to belong to, species, to compare to, middle, to conclude, evenness, the most dominant species, a preliminary checklist, interaction, ebbing tides, rocky shores, to face, salinity, challenge, resilient and resistant organisms, algae, lichens, barnacles, sandy coral, limestone, to adorn, cliffs, a turtle, a breakwater, substrate, to bury, slippery and heavy shells, phylum, feature, to house, the main axis, at the bottom, a dig, collecting data, specimens, validity, a murex, marine habitats, [a humidity conservation, during, a low tide, the evenness index, to range, middle, detritus feeders, abundance, enhanced knowledge, while, to maintain, survival, to adapt, scattered, an unbalanced aquatic environment, to exist, community, competition, supportive environmental conditions, to state, to occupy, to breed, exposure, immersion, value, competitors, predators, food sources, to affect, attempt, to survey, to contribute, complete.

**Exercise 3. Answer the questions:**

1. What do we mean using the term “the intertidal zone”?
2. What is the intertidal region?
3. What do organisms found on rocky shores face?
4. What way and where was the sampling carried out?
5. What was the implementation technique to determine?
6. What can you say about Muricidau?
7. What can you say about molluscs?
8. Describe station 1.
9. How many species from the class Gastropods and from the class Bivalvia in the upper, middle, and lower intertidal zones did this research find?
10. What are temperature variations at each research station closely related to?
11. What can the diversity index show?
12. What may affect the value of mollusc diversity in the study area?
13. What were identified, counted, and recorded in the field?

**Exercise 4. Make up as more sentences as you can using the words and expressions from exercise 2.**

**Exercise 5. Make up 25 different type questions for this text.**

**Exercise 6. Write a brief summary of the text.**

### *Note that:*

- A summary begins with an introductory sentence that states the article's title.
- A summary must contain the main thesis or standpoint of the text, restated in your own words.
- A summary is written in your own words.
- A summary is always shorter than the original text, often about 1/3 as long as the original.

**Exercise 7. Read your summary of the text to your groupmate and ask him to retell it.**

**Exercise 8. Make up a plan of this text. Retell the text according to it.**

## **GRAMMAR**

### **Indirect speech (Reported speech)**

Reported speech is when we tell someone what another person said. To do this, we can use direct speech or indirect speech.

*direct speech:* 'I work in a bank,' said Daniel.

*indirect speech:* Daniel said that he worked in a bank.

In indirect speech, we often use a tense which is 'further back' in the past (e.g. *worked*) than the tense originally used (e.g. *work*). This is called 'backshift'. We also may need to change other words that were used, for example pronouns.

#### **Present Simple, Present Continuous and Present Perfect**

When we backshift, present simple changes to past simple, present continuous changes to past continuous and present perfect changes to past perfect.

'I travel a lot in my job.' - Jamila said that she travelled a lot in her job.

'The baby's sleeping!' - He told me the baby was sleeping.

'I've hurt my leg.' - She said she'd hurt her leg.

#### **Past simple and past continuous**

When we backshift, *past simple* usually changes to *past perfect*, and *past continuous* usually changes to *past perfect continuous*.

'We lived in China for five years.' - She told me they'd lived in China for five years.

'It was raining all day.' - He told me it had been raining all day.

#### **Past Perfect**

The past perfect doesn't change.

'I'd tried everything without success, but this new medicine is great.' - He said he'd tried everything without success, but the new medicine was great.

#### **No backshift**

If what the speaker has said is still true or relevant, it's not always necessary to change the tense. This might happen when the speaker has used a present tense.

'I go to the gym next to your house.' - Jenny told me that she goes to the gym next to my house. I'm thinking about going with her.

'I'm working in Italy for the next six months.' - He told me he's working in Italy for the next six months. Maybe I should visit him!

'I've broken my arm!' - She said she's broken her arm, so she won't be at work this week.

### **Pronouns, demonstratives and adverbs of time and place.**

Pronouns also usually change in indirect speech.

'I enjoy working in *my* garden,' said Bob. - Bob said that he enjoyed working in *his* garden.

'We played tennis for *our* school,' said Alina. - Alina told me they'd played tennis for *their* school.

However, if you are the person or one of the people who spoke, then the pronouns don't change.

'I'm working on my thesis,' I said. - I told her that I was working on my thesis.

'We want our jobs back!' we said. - We said that we wanted our jobs back.

We also change demonstratives and adverbs of time and place if they are no longer accurate.

'This is my house.' - He said this was his house. [You are currently in front of the house.] He said that was his house. [You are not currently in front of the house.]

'We like it here.' - She told me they like it here. [You are currently in the place they like.] She told me they like it there. [You are not in the place they like.]

'I'm planning to do it today.' - She told me she's planning to do it today. [It is currently still the same day.] She told me she was planning to do it that day. [It is not the same day any more]

In the same way, *these* changes to *those*, *now* changes to *then*, *yesterday* changes to *the day before*, *tomorrow* changes to *the next/following day* and *ago* changes to *before*.

### **Indirect questions**

We normally use indirect questions, when we want to be more polite. We begin the question with expressions such as Can you tell me ...? Could you tell me ...? Do you know ...? Would you mind telling me ...?

*What time is it?* (direct question)

*Could you tell me what time it is?* (indirect question)

In indirect questions the order is subject + verb.

*Do you know where I can find a bank?* (NOT

*Can you tell me what time the shops close?* (NOT ...)

There are other expressions that follow the same rule:

*I don't know what he is doing here.  
I wonder when he will find the truth.  
I'm not sure when I can come.  
I'd like to know where you left the documents.*

For yes-no questions (when there is NO question word), we can use both *if* or *whether*:

*Do you know if/whether he'll be here soon?*

### **Grammar exercises**

#### **Exercise 1. Change the following sentences into Indirect Speech.**

1. "When your turn comes, listen very carefully to what the doctor tells you," I said to my grandmother. 2. "If you are in a hurry, we shall do only the first experiment," said the laboratory assistant to me. 3. "I shan't start anything new until I have finished this novel," said the writer to the correspondent. 4. "When I get a job, I'll buy you a warm coat," said the boy's father. 5. "If you spill the milk, there won't be any for the cat," said my mother to me. 6. "When you come to see me on Sunday, I shall show you my new dress," she said to me. 7. "If Mary arrives before seven, bring her to our house for the evening," said Jane to Henry. 8. "Don't wait until I come. As soon as you finish the exercises, begin playing volleyball," said the PT teacher to the pupils. 9. "As soon as Robert appears, ask him where he put the dictionary," said Mary to her mother.

#### **Exercise 2. Change the following sentences into Indirect Speech.**

1. Jack told his father, "I hope to pass the examination." 2. Henry said to me, "The teacher is listening to us." 3. Bob said to Tom, "I made no mistakes in the last dictation." 4. I told the policeman, "I saw the thief in the garden." 5. He said, "I haven't read many English books." 6. Jack's father said to him, "You haven't cleaned your shoes." 7. Mary said, "I don't want to wear my old dress." 8. My mother said to me, "I feel very tired, and I have a headache." 9. My friend told me, "We have plenty of time to do our work." 10. I said to my sister, "I haven't seen my uncle for a long time."

#### **Exercise 3. Change the following sentences into Direct Speech.**

1. My sister said that she hadn't got a watch. 2. The teacher told his students that he was pleased with their work. 3. I told him that I hadn't seen his brother for a long time. 4. I told my mother that Henry was studying medicine at the University. 5. She told the grocer that she didn't want any sugar. 6. We told the teacher that we didn't understand his question. 7. I told the taxi driver that he was driving too fast. 8. She said that her children were playing in the garden.

**Exercise 4. Choose the correct word from those in brackets.**

1. My grandmother always \_\_\_\_\_ me about her childhood, (says/tells)
2. "Don't do that!" she \_\_\_\_\_ them, (said/told)
3. Did she \_\_\_\_\_ you where she had put my books? (say/tell)
4. When I was introduced to the actor he \_\_\_\_\_ a few words to me. (said/told)
5. That little boy is very bad. He \_\_\_\_\_ a lot of lies, (says/tells)
6. She \_\_\_\_\_ to me she didn't know what to do. (said/told)
7. He often \_\_\_\_\_ things like that, (says/tells)

**Exercise 5. Put in the appropriate forms of "ask", "say" and "tell".**

**Who Has the Last Say?**

Some people always ... that they don't build cars as they used to. What nonsense! I walked round the beautiful new Ferrari again, admiring the lines, when my thoughts were rudely interrupted. "Will you be long?" a voice ... sharply. "I haven't made up my mind yet," I ... looking up at a sour-faced traffic warden. "Well, you can't stop here," he ... me. "Who ... so?" I... him cheekily. "I... so," he ... to me. "It... here," he added, "in case you can't read, "No waiting." "You read very well. Go to the top of the class," I... him, "but I'll make my own decisions." "Oh, will you?" the traffic warden ... "Then so will I and I've decided to give you a ticket," he ... to me with relish as he began filling out the form. "Go ahead," I... him. "This car doesn't belong to me anyway. I wish it did."

*(From Alexander L. G. "Longman English Grammar for intermediate students")*

**Exercise 6. Change the following sentences into Indirect Speech. Decide whether to use "told" or "asked", or whether either of these two verbs is suitable.**

1. Mary said to her brother, "Take the letter to the Post Office, please."
2. The teacher said to Tom, "Collect the exercise-books and put them on my table."
3. The old man said to the little girl, "Don't run across the street."
4. The teacher said to the pupils, "Learn the poem by heart."
5. I said to my friend, "Meet me outside the cinema at six o'clock."
6. Mary's mother said to her, "Don't go out without your coat."
7. The teacher said to the students, "Open your books at page 60."
8. The doctor said to the sick man, "Don't go back to work for a fortnight."
9. Jack said to the policeman, "Tell me the time, please."
10. The teacher asked Tom, "Do you come to school by bus or on foot?"
11. A man stopped me in the street and asked, "Have you got a match?"
12. The teacher asked us, "Do you understand the question?"
13. Henry's father asked his son, "Do you want to be an engineer or a doctor?"
14. I asked Peter, "Are you going to play football on Friday?"
15. He asked his secretary, "Has the postman been yet?"

**Exercise 7. Change the following sentences into Indirect Speech.**

1. Mother asked Jane, "What are you doing here?" 2. Margaret asked Richard, "Where are you going for your holidays?" 3. Ann asked Mary, "What do you usually have for breakfast?" 4. The inspector asked, "Who caused the accident?" 5. The teacher asked Bob, "When did you learn to swim?" 6. Mary's mother asked her, "Where have you put your shoes?" 7. The teacher asked, "Which number can be divided by three?" 8. Peter asked me, "When are you going to have dinner?" 9. The policeman asked me, "Where did you lose your wallet?" 10. The teacher came into the classroom and asked the pupils, "What are you doing?" 11. I asked Bob, "Why didn't you answer my letter?" 12. There was a crowd in the street. I asked a man in the crowd, "What is the matter?" 13. Father asked, "When will lunch be ready?" 14. The little boy asked his father, "Why does the policeman wear a uniform?" 15. I asked him, "Who are you looking at?" 16. The nurse asked, "Who is the next, please?" 17. The man asked his friend, "When did you buy your car?"

**Exercise 8. Put the following into Indirect Speech.**

1. I asked my friend, "How do you feel after your holiday?" 2. "Ernie's an educated man," remarks Florrie. 3. "John never seems low or depressed," says Jane. 4. Jack's father asked him, "Who are you writing a letter to?" 5. "Jack is on the terrace. He is playing chess with his brother," says Nelly. 6. I saw a cloud of smoke and asked, "What is burning?" 7. "I can't understand what he is talking about," replies Bessie. 8. I asked her, "Who gave you that watch?" 9. "I'll tell you when I'll be back," Nora says to Jack. 10. Mr. Nyman asked his wife, "How much do you spend on food every week?" 11. "You have known me long," Barbara says to Martha. 12. "You're the best assistant I've ever had, Sheppey," he says. 13. Henry asked Tom, "Who did you visit in the hospital?" 14. "He was born in Moscow," she says. 15. "We didn't have dinner there," the boy says. 16. "I was so thrilled and excited by the opera," Stella says to Maurice. 17. "When I came Jane was playing the piano," says Kitty. 18. "When the doorbell rang I was writing a letter to John," says George.

**Exercise 9. Put the following into Indirect Speech.**

1. "He always has dinner there," she said. 2. "He has a nice voice," she said. 3. "I'm quite prepared to stay up until Mrs. Maurice comes in," said Stella. 4. "I'm sorry to disturb you," Tom said to Eliza. 5. "I'm her guest at the moment," he said. 6. "You are the very person we want, Thornton," said Pearl. 7. "John always comes home to luncheon," said Martha. 8. "I don't think anyone can accuse me of not being frank," said Martha. 9. "I'm learning French," said Florrie. 10. "The taxi is waiting," Bently said to Constance. 11. "Florrie, you'll be all right in a minute," said Bessie. 12. "I'll go in and see him before I go to

bed," said Stella. 13. "You won't be able to see me on Tuesday," she said to Jack. 14. "We shall not do that," he said. 15. "I shall wait for Sheppey," said Bolton. 16. "Whatever the future may have in store I shall never forget your courage, your self-sacrifice, and your patience," Mrs. Tabret said to Stella. 17. "I'm deeply grateful for all you've done for Maurice," Mrs. Tabret said to Stella.

**Exercise 10. Put the verbs in brackets into the required past tense, pay attention to the Sequence of Tenses.**

1. She (hear) the band playing and she (know) that in a few moments the curtain (go) up. 2. Myra (think) he (prefer) to be by himself. 3. I (hear) from your mother that you (be) late and so I (order) coffee and sandwiches. 4. Mrs. Streep (ask) him if he (have) dinner there. 5. The old man (ask) me if I (have) parents. 6. He (be) very sorry for Jennie, and he (tell) his wife that he (have) to go out and see her. 7. And the other day I (have) a letter from him saying he (be) in Moscow soon. 8. I (say) I (be) back by nine o'clock. 9. You (promise) you (try) to persuade him to stay on for a bit. 10. In a few words I (tell) him what (happen). 11. She (ask) me if I (live) long in that town. 12. When I (ring) her that evening she (say) she (not like) to discuss those problems on the phone. 13. That evening she (tell) me (be) at the hotel number, and about half past eight I (dial) that number, but there (be) no answer. 14. I (put) the papers back where they (belong), (tell) the manager I (do) no clipping or tearing, (return) to the hotel, (treat) myself to a glass of milk in the coffee shop, and (go) to bed. 15. He (write) that he (come) to lunch the following day.

**Exercise 11. Put the following into Indirect Speech.**

1. "Lock the door when you leave the house," said my elder sister to me. 2. "Have you received a telegram from your wife?" she asked Robert. 3. Mabel said, "Nothing will change my decision and I shall leave for Cape Town tonight." 4. "Pease don't smoke in the room," said the old woman to her nephew. 5. "I am shivering with cold," said the girl. 6. "I want to sit in the armchair," said the boy. 7. The secretary said to me, "The delegation arrived in St. Petersburg yesterday." 8. "Open the window, please," she said to me. 9. He said, "I shall light a fire and make myself breakfast." 10. "Don't run to the door when you hear the bell," said the woman to her little daughter. 11. She asked me, "How long are you going to stay here?" 12. Mary asked me, "Will you spend your vacation in Moscow?"

**Exercise 12. Put the following into Indirect Speech.**

1. Father said to Jane, "Show me your exercise book." 2. "What are you doing here, boys?" said Kate. 3. "Don't make noise," said Tom's mother to him. 4. Helen said to Pete, "Did you play chess with your father yesterday?" 5. Kate

said to her grandmother, "Help me (to) cook the soup, please." 6. Mike said to the teacher, "My sister knows two foreign languages." 7. Tom said to his sister, "I saw your friend at the library yesterday." 8. "What have you prepared for today, children?" said the teacher. 9. The teacher said to the pupils, "Don't open your books." 10. Mother said to me, "You will go to the cinema tomorrow."

**Exercise 13. Put the following into Indirect Speech.**

1. "Tom, go to bed," said his mother. 2. "I have never seen your toys," said Nellie to Pete. 3. "Give me your record book, Nick," said the teacher. 4. Ann said to Lena, "Look at my nice kitten." 5. "We shall go to the zoo tomorrow," said our grandmother. 6. Mother said to Pete, "Don't forget to wash your hands." 7. Nick said to his mother, "I am doing my homework." 8. "I have learnt a long poem," said Mike to the teacher. 9. "Don't play in the street," said the man to the boys. 10. "Why don't you drink your tea?" said my mother to me. 11. "I saw my friend at the stadium yesterday," said Johnny to his mother. 12. "When did you receive this letter?" my friend said to me.

**Exercise 14. Restore Direct Speech in the following sentences.**

1. I asked my aunt if she was going to her hometown for the holidays. 2. He told me that he hadn't been able to ring me up in time. 3. He asked his classmates to wait for him. 4. He asked her if anyone else knew about his arrival. 5. I asked him when he would take his last examination. 6. He asked me if I had taken part in the football match. 7. She asked me where I lived. 8. He said that he had joined a sports society. 9. He told me that he had seen my brother the day before. 10. She asked me to hurry up as there was little time left before the beginning of the meeting. 11. She asked her friend if the rain had stopped. 12. He answered that it was still raining. 13. My sister told me that she had found the book I was looking for. 14. He said that he didn't like the main character of the book but he could not explain why. 15. He asked his brother what he would do if he did not find the book he needed.

**Exercise 15. Restore Direct Speech in the following sentences.**

1. The man told us to have our passports ready. 2. He told us to pass up the gangway. 3. He said we would find our luggage on deck. 4. I asked my friend if he would go down to his cabin or stay up on deck. 5. He said he was a bad sailor and could not stay on deck. 6. We told the porter to take our luggage to cabin number eight. 7. I asked my friend if he often went to England. 8. He said he did not cross the English Channel very often for it was rough as a rule. 9. My friend asked me if I knew when the boat was due at Southampton. 10. I asked my friend if he thought it would take us long to get through the customs.

**Exercise 16. Answer the questions using Indirect Speech.**

*E.g. "I like novels written by Dickens," said Nina to her friend Vera. "I have read many of them." What did Nina say to Vera?*

*Nina told Vera that she liked novels written by Dickens and that she had read many of them.*

1. "My favourite books are 'Gulliver's Travels' and 'Robinson Crusoe'," answered Vera. "And now I am reading a novel by Walter Scott."

What did Vera answer Nina?

2. "Last year we learnt some poems by Byron and Shelley, they are so beautiful," said Nina.

What did Nina say?

3. "I know many poems by these great poets. I have read some books about Byron and Shelley too," said Vera.

What did Vera tell Nina?

4. "This year we shall read a play by Shakespeare in English," said Nina.

What did Nina say?

**Exercise 17. Put the following into Indirect Speech.**

1. "When your turn comes, listen very carefully to what the doctor tells you," I said to my grandmother. 2. "If you are in a hurry, we shall do only the first experiment," said the laboratory assistant to me. 3. "I shan't start anything new until I have finished this novel," said the writer to the correspondent. 4. "When I get a job, I'll buy you a warm coat," said the boy's father. 5. "If you spill the milk, there won't be any for the cat," said my mother to me. 6. "When you come to see me on Sunday, I shall show you my new dress," she said to me. 7. "If Mary arrives before seven, bring her to our house for the evening," said Jane to Henry. 8. "Don't wait until I come. As soon as you finish the exercises, begin playing volleyball," said the PT teacher to the pupils. 9. "As soon as Robert appears, ask him where he put the dictionary," said Mary to her mother.

**Exercise 18. Turn the following into indirect speech. Begin the indirect speech with *They said ...*, *he said ...*, or use any suitable names.**

- 1) We must catch an early train. 2) I can't forgive such insults. 3) The boy ought to be punished for his rudeness. 4) You should speak more distinctly. 5) We may buy a few pieces of furniture if we get the money. 6) You needn't read all the books in the list. 7) The pupils daren't breathe a word in the presence of the director. 8) The tickets must be awfully expensive. 9) The film is to be released in a few days. 10) I have to change on the way home. 11) We could not get the medicine. 12) We leave in half an hour. You're to be ready in ten minutes. 13) We must not be late. 14) She ought to have phoned me at nine but she didn't. 15) Nick was to have met me for lunch but he didn't. 16)

She can't be operated on now. It is too late. 17) The plane was to land at 10 a. m. 18) They had to buy a present for the young couple. 19) I could not make out what he was saying. 20) They must be crazy to spend so much time on dancing.

**Exercise 19. Render the following sentences into direct speech.**

1) Jack said he wanted to read some book on space exploration. 2) My friend said he had enjoyed his trip to the Baikal lake. 3) Tom said he had booked tickets for a fast train. 4) Jack told his sister that he was going to take her to the Zoo. 5) Mary said she was working at a report on the latest achievements in chemistry. 6) Mother said I ought to be more careful. 7) They said I might call any day I liked. 8) Tom said his sister was good at sports and had won several competitions. 9) John told Mary that he would stay at the seaside for another week. 10) Hen said he knew a girl who was a champion in parachute jumping. 11) Betty said she dared not speak to her father when he was in one of his bad moods. 12) The girl told her mother that she had not been able to let her know she would be late. 13) The students said they would go sightseeing and take pictures of all the places of interest. 14) Jack told his friend that he had been waiting for him more than an hour. He was glad he had come at last. 15) Arnold said he had met Peter on his way home. 16) Peter said it had been raining all night. 17) The boy said he must read many articles for his exams. 18) The teacher said we needn't write any more papers on the subject.

**Exercise 20. Turn the following questions into indirect speech. Begin the indirect questions with *He asked me ..., He inquired...***

1) Are you a football fan, Bob? 2) Is John reading much for his exams? 3) Were all the letters posted yesterday? 4) Are there any bathing suits on sale? 5) Has the fog lifted yet? 6) May I keep the book a few days longer? 7) Did you see anything interesting on TV last night? 8) Will Bob go on with his studies next year? 9) Must you work so hard? 10) Are the books to be returned this week? 11) Shall you be able to help us with the concert? 12) Have they all gone to the pictures? 13) Have you had your watch mended? 14) Will he be working this time tomorrow? 15) Have you been waiting for him long? 16) Is the weather going to clear up? 17) Is Henry likely to take up hockey? 18) Have you made any plans for the summer?

**Exercise 21. Turn the following conversations into indirect speech.**

1. "Is there a hotel here?" asked Mrs. Macphail. Davidson gave a low chuckle. "There is not." (*Maugham*)
2. A voice said, "Oh, there you are! Look!" Ashurst rose, took his wife's sketch, and stared at it in silence. "Is the foreground right, Frank?" "Yes." (*Galsworthy*)
3. ... the halfcaste stopped him as he was going upstairs. "Excuse me, Dr. Macphail, Miss Thompson's sick. Will you have a look at her?" "Certainly." (*Maugham*)
4. "Rosemary, may I come in?" It was Philip. "Of course." (*Mansfield*)
5. "Is this your daughter?" he continued, with a smile at Jennie. "Yes, sir," said the mother; "she's my eldest girl." "Is your husband alive? What is his name? Where does he live?" To all these questions, Mrs. Gerhardt very humbly answered. "How many children have you?" he went on. "Six," said Mrs. Gerhardt. "Well," he returned, "that's quite a family. You've certainly done your duty to the nation." (*Dreiser*)
6. "How is your mother?" he asked pleasantly. "She's very well," said Jenny simply. "And your little sister? Is she any better?" "The doctor thinks so", she replied. (*Dreiser*)

## LESSON VI

### Text

**Exercise 1. Translate the text using a list of unknown words.**

### **The ACP Group of States and the challenge of Developing Aquaculture**

Pierre Failler\* and Hachim El Ayoubi\*\* \*:

Economics and Finance Group  
Portsmouth Business School University of Portsmouth Richmond Building, Portland Street  
Portsmouth, PO1 3DE, UK United Kingdom  
tel +44 (0)2392 848 505  
fax: +44 (0) 2392 844 614  
pierre.failler@port.ac.uk \*\*::

Fisheries and aquaculture expert Fisheries Department Rabat,  
Morocco tel +212 6 19 55 58 86 [hachim.elayoubi@gmail.com](mailto:hachim.elayoubi@gmail.com)

### **Abstract**

Aquaculture production is developing increasingly in the world and, as years go by is becoming a viable alternative to the exhaustion of resources from catching fish. Currently one-half of all food fish supply comes from aquaculture. The increase in aquaculture production meets a growing demand for fish, but also corresponds to a reduction in catches by industrial and small-scale fishing. For ACP Group States, important progress has been done to promote aquaculture however with differing stages of development depending of the investments and capacities of each country and region stretching from commercial phase of development to the initial stage of growth. For these countries, aquaculture sector often encounters problems, among which are institutional constraints, poor management practices and environmental risks such as water pollution, propagation of diseases to fish-farm populations, excessive use of antibiotics and harmful effects on biodiversity.

### **Introduction**

According to the FAO, world aquaculture production has reached a new record: in 2012 with the production of 90.4 million tonnes (for a value of US\$ 144.4 billion), of which 66.6 million tonnes of fish for consumption and 23.8 million tonnes of algae, and for 2013, estimates are for 70.5 million tonnes and 26.1 million tonnes respectively. Asian countries are those where the evolution of aquaculture production is most marked while total production of all African, Caribbean and Pacific Group of States (ACP) (The ACP Group represents 79 member States in Africa, Caribbean and Pacific. For list of member States and details, see: [www.acp.org](http://www.acp.org)) represents less than 1% of world aquaculture

production. In fact, aquaculture has taken time to develop in most ACP states. One of the reasons for this is that many projects focus on species that are extremely dependent on imported fish food and fingerlings – like tropical shrimp – intended for international markets and already dominated by a few countries (Southeast Asia, Chile, Norway). In the case of the IACT Pacific project (Increasing Agricultural Commodity Trade (IACT)). The main goal of IACT project is to strengthen the export capacity of Pacific member countries in the primary industries of agriculture, forestry, aquaculture and livestock), the type of aquaculture concerned – marine algae and tilapia – is less dependent on fish food (In the case of tilapia, fish food is not necessary, but it is often used to speed growth). A large share of the production is sold on local and regional markets. In this case, aquaculture represents production of essential nutritive elements (proteins, minerals) and consequently contributes to meeting nutritional needs of local populations. However, a certain number of important questions must be answered if sustainable development of aquaculture is to be encouraged. First, many types of aquaculture depend on capture fish for fish meal, the choice of fish species that can use essentially vegetarian food produced on the spot is an important element to ensure long-term viability. Secondly, the fact that fish produced can be sold on local and regional markets can be a positive factor in improving the contribution of fish to food security at local and regional level, and decreasing dependence on international markets where constraints associated with changing standards are increasing. The purpose of this paper is to look at the major progress made in aquaculture sector in ACP Group It also identified a number of areas to promote aquaculture development in both marine and freshwater systems.

### **Trend and Progress**

Several studies emphasize the role that aquaculture can play to fill the gap between supply and demand for fish and the potential reduction of pressure exercised on catch fish. According to a World Bank communication, aquaculture will certainly dominate the supply of fish of the planet after 2030. This activity will provide nearly two-thirds of world fish production intended for food by 2030, given the stabilization of catches of wild fish and the growing demand on a worldwide scale of an emerging middle class particularly in China. For ACP Group, Ghana, Kenya, Nigeria, Uganda, Papua New Guinea and Zambia have become major aquaculture producers in recent years with production ranging from small family farms to intensive hightechnology systems. In these countries, freshwater fish are farmed with increasing success: Nigeria's modern hatcheries produce more than half a million wels catfish fingerlings per month, and the country has more than 5000 aquaculture farms. The production of tilapia has also greatly increased, particularly in Zimbabwe and Ghana, and the entire production chain is growing: hatcheries, farms, production of quality fish food, etc.

For aquaculture planning, several ACP countries have made significant progress in developing commercial aquaculture (particularly fish farming) and their success can be used elsewhere to the benefit of other ACP countries. The certain countries like Nigeria, Ghana and Zimbabwe, Papua New Guinea, Jamaica and Belize have considerably developed their aquaculture production, to a large extent using freshwater species like tilapia and shrimp as a secondary product (Failler P & El Ayoubi H, 90,4 63,1 Capture Aquaculture 93,2 93,6 Capture Aquaculture Total harvest 154 million tons 2011 (data) 2030 (projection) Total harvest 186,6 million tons 2015). Other countries, specifically Madagascar, have given aquaculture new drive and life thanks to shrimp farming. Namibia has developed mariculture based on farming sea cucumbers, lobster, oysters and shellfish.

Development of national aquaculture frameworks in several ACP countries began by defining national fishery and aquaculture management strategies. However, and although frameworks for aquaculture generally are little developed at ACP country level, regulations or tax schemes exist concerning rights to exercise this activity, as is the case in Belize and the Seychelles whose aquaculture development plan is scheduled for 2015. In addition, incentives are used by governments in certain countries like Benin (Failler & El Ayoubi, 2013) which adopted a framework offering specific conditions for aquacultural investors, such as tax exemption on imports up to nine years for new producers to develop aquaculture. In other cases, the Fishing Code in force does not include specific measures for aquaculture, as is the case in Guinea where this activity is still marginal. However, review of the framework is going forward to take account of these aspects, particularly access to land which is still challenging.

### **Infrastructures constraints**

On the question of improving infrastructures, several ACP countries stress the poor condition of their roads for gaining access to aquacultural production zones located in rural areas. Currently, large aquacultural farms must integrate the cost of building access roads in their budgets, as is the case in Benin and Nigeria for example. As concerns specific infrastructures for aquacultural activities, these are projects entailing an extensive system of small-scale producers using ponds, at times alongside dams, to produce fish (fingerlings and fish). Generally, the investments made are limited to the production basin and ponds. In fact, fish food producers in these countries only produce floating rations for fish, and fish food continues to be imported to producing countries (Nigeria, Ghana, Senegal) and in the absence of granular fish food, this represents a high cost for producers and explains the difficulty of having access to a quality, profitable food product. So the progress recorded in terms of developing infrastructures is still limited

and there are few achievements at this stage. Namibia is one of the exceptions. Indeed, this country has set up an aquaculture Master plan and invested massively in the development of infrastructures such as ponds, reproduction units, fish food factories while encouraging public-private partnerships in aquaculture. The country has also set up a centre of excellence, the Kamutjonga Inland Fisheries Institute (KIFI) that is supported technically and financially by CETMAR, FAO, Cuba and Vietnam.

### **Technical support**

Several technical assistance projects have been carried out in ACP countries. Some of them were done via South-South cooperation with the support of Asian countries (Vietnam, Thailand). Japanese cooperation also is active in several African countries with projects geared mainly to generalizing extensive aquaculture by families.

Finally, the ACP Fish project contributed to reinforcing national and regional research strategies by training players in the public and private sector in the aquaculture field and by improving food rations for developing aquaculture in Mozambique. The project also supported institutional aspects by contributing to drafting the aquaculture development strategy particularly in Botswana, and reviewing the national policy in Mali. In 2002, a new project financed by the EU and managed by the FAO was launched in Uganda, Kenya and Zambia to promote aquaculture as an instrument to fight hunger. This was part of a more general policy targeting aid to low income countries with deficits in the fish sector to develop sustainable aquaculture policies.

### **Market development**

As concerns developing markets, according to the FAO currently 38% of all fish produced is traded internationally, and more than two thirds of the value of exports of fish products in developing countries are intended for industrialized countries. Although aquaculture plays an increasingly large role in the world trade of fish (about half of the trade), the sector is relatively underdeveloped in ACP regions. Consequently, there are still several questions about access to markets that trouble ACP governments, but many potential fields of action could reinforce the contribution of the fishing sector to national economic development. Sub-Saharan Africa, conversely, should see its fish consumption per capita decline by 1% per year from 2010 to 2030. However, given the rapid demographic growth of 2.3% during the same period, total fish consumption in the region will grow by 30%.

Depending on the type of aquaculture operation, three types of markets can be identified in the ACP region. Factors such as production costs and the type of fish also determine the destination market (Another important aspect in

developing the aquaculture market in ACP countries is the growth of the networks in the private sector created via cell telephones and Internet):

- ♣ Access to regional markets is easier for industrial operations that are familiar with distribution and supply circuits. Operations of this kind are limited and are found mainly in Nigeria, Ghana, Benin, Namibia and in Belize. Regional markets, like the ECOWAS, facilitate the development of trade.

- ♣ Local markets: these are mainly products intended for the national urban or rural market. The rural market constitutes an opportunity to meet the needs of the population and to replace frozen fish.

- ♣ International export market: tropical shrimp produced in Madagascar and marine algae. The application by the EU of sanitary and phytosanitary standards (SPS) and requirements for the security of food products limits access of aquaculture products from ACP countries to these markets.

### **Perspectives**

FAO studies have shown that improving aquaculture production offers considerable physical potential to respond to a rise in demand for fish. A new FAO study shows that aquaculture benefits local communities (REF).

Access to land for aquacultural investors is very complex and varies from one country to the next. The lack of clarification of the laws on water and land use in national legislation constitutes a constraint for developing fish farming in cages like in Lake Volta. Indeed, land ownership often represents a major constraint in rural areas. In addition, aquaculture is faced with the question of environmental sustainability -- in an extensive scheme, practiced by small-scale producers, it must deal with issues pertaining to food security, quality and traceability. Aquaculture is in competition with other rural activities for the use of water and is likely to be subject to growing pressure on the limited water supply, all in a context characterized by growing diversification and climate change.

What is at stake is better optimizing production systems, particularly in fresh water, and controlling costs of the fish food needed, which also requires additional use of fresh water. Fish farming is still in the development stage in many ACP countries, and can learn from the experience of regions like Asia or Latin America, where the aquaculture industry has already taken off. However, this experience indicates the risks run by the coastal environments due to the major use of inputs from capture fishing (fish meal and fish oil). In June 2013, the CTA organized a Briefing on development in Brussels pertaining to fish farming. It brought in various experts to discuss the stakes and opportunities of developing aquaculture in ACP countries to ensure food and nutrition security. The meeting underscored the need to develop aquaculture in a sustainable way both from the social standpoint and that of the economy and the environment. National strategies and policies on developing aquaculture still need to be

generalized in ACP countries. These strategies must be realistic, specific and have clear objectives. The definition of the roles and responsibilities of each sector: government, private sector, research, market, NGOs, should facilitate the implementation of strategies now being developed. Access to production sites (infrastructures), land use and the nature of the tax regime can act as incentives for developing aquaculture. Finally, taking environmental standards into account in the development of the activity should allow for sustainable aquaculture.

Regional trade agreements can play a beneficial role in developing markets for aquaculture from ACP countries. As an example, setting up the customs union in the East African Community of which Uganda, Kenya, Tanzania, Rwanda and Burundi are members, considerably improved free movement of goods in the region, including for fishing by-products (fingerlings sold directly for fish farming, fresh or processed fish). With the probability that South Sudan will join the EAC, the perspectives for extending the trade to new markets will be improved. Finally, strong demand for fish on national and regional markets in Africa will lead to a change in the destination of certain products like tilapia. For example, the largest tilapia farm in Africa, located in Zimbabwe, which had developed strict European norms of production, now mainly supplies African markets for 90% of the production and 10% to the EU market.

## **Conclusion**

The aquaculture production can provide some affordable animal protein to the rising population of ACP. The ACP Group is now engages with its strategic plan of action in fisheries and aquaculture to promote significantly aquaculture development in both marine and freshwater systems. This Plan identifies support for aquaculture production in 4 main areas: (1) Regulatory framework; (2) Infrastructure; (3) Technical requirements and (4) Market development. Several initiatives to promote aquaculture are developed in ACP group. However the new initiatives should be in line and supplement these existing activities. Development of aquaculture in ACP group should meet the requirement for sustainable development: environmental sustainability and economic sustainability including trade issues.

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**Exercise 2. Translate and study the following words and expressions:**

Post hoc, a viable alternative, exhaustion, currently, a reduction, to promote, investments, capacities, the initial stage of growth, institutional constraints, poor management practices, environmental risks, harmful effects, biodiversity, to estimate, extremely dependent, tropical shrimp, to strengthen, the export capacity, the primary industries, agriculture, forestry, aquaculture, livestock, marine algae, tilapia, a large share, essential nutritive elements, sustainable development, to be encouraged, to depend on, capture, to ensure long-term viability, contribution, food security, local and regional level, decreasing dependence, constraints, associated, to emphasize, gap, between, communication, to intend, wild fish, the entire production chain, hatcheries, sea cucumbers, lobster, oysters, shellfish, tax schemes, incentives, to adopt, offering, tax exemption, to include, particularly, access, to land, to gain, rural areas, floating rations, deficits, sustainable aquaculture policies.

**Exercise 3. Answer the questions:**

1. What role can aquaculture play to fill the gap between supply and demand for fish?
2. What have several ACP countries made for aquaculture planning?
3. How did development of national aquaculture frameworks in several ACP countries begin?
4. What constitutes a constraint for developing fish farming in cages?
5. What do national strategies and policies on developing aquaculture still need?
6. What should allow for sustainable aquaculture?
7. What can act as incentives for developing aquaculture?
8. What can play a beneficial role in developing markets for aquaculture from ACP countries?
9. What can the aquaculture production provide for the rising population of ACP?
10. What main areas must be developed and supported for aquaculture production?

**Exercise 4. Make up as more sentences as you can using the words and expressions from exercise 2.**

**Exercise 5. Make up 25 different type questions for this text.**

**Exercise 6. Write a brief summary of the text.**

*Note that:*

- A summary begins with an introductory sentence that states the article's title.
- A summary must contain the main thesis or standpoint of the text, restated in your own words.
- A summary is written in your own words.
- A summary is always shorter than the original text, often about 1/3 as long as the original.

**Exercise 7. Read your summary of the text to your groupmate and ask him to retell it.**

**Exercise 8. Make up a plan of this text. Retell the text according to it.**

## GRAMMAR

### The Subjunctive mood

Subjunctive is a form or mood of verbs that helps us talk about wishes, possibility or uncertainty. The subjunctive mood is a verb form or in English that is used to express desires, suggestions, doubts, or hypothetical situations. By using the subjunctive mood, the speaker can convey a sense of uncertainty or possibility, and express ideas that are not necessarily rooted in fact.

There are two types of subjunctive verb forms. Verbs in the **present subjunctive** take the infinitive form (e.g., "be"), while verbs in the **past subjunctive** are identical to their simple past forms (e.g., "ran").

Examples: *Sentences in the subjunctive mood:*

I demand that everyone **have** an opportunity to speak.

Sharon insisted that she **be** notified of any problems.

If Jane **were** here, she could tell us what to do.

*Note!*

*The subjunctive mood is less common in UK English than US English. In UK English, the modal verb "should" is often used instead of a subjunctive verb (e.g., "Sharon insisted that she should be notified of any problems").*

The grammatical mood of a verb indicates the intention of a sentence. The subjunctive is one of three grammatical moods in English:

| Grammatical mood | Function            | Example                                       |
|------------------|---------------------|-----------------------------------------------|
| Indicative       | Express a fact      | "Paris <b>is</b> a city."                     |
|                  | Ask a question      | "Did you <b>get</b> my message?"              |
|                  | Express a condition | "You can take a break if you <b>want</b> to." |

| Grammatical mood                    | Function                                                      | Example                                  |
|-------------------------------------|---------------------------------------------------------------|------------------------------------------|
| Imperative                          | Express a command or a request                                | “ <b>Stop</b> talking.”                  |
| Subjunctive The present subjunctive | Express a wish, suggestion, demand, or hypothetical situation | “I wish I <b>were</b> more intelligent.” |

## The present subjunctive

The present subjunctive is typically used to refer to future actions or situations. Sentences in the present subjunctive mood have two clauses:

- A main clause that contains either an indicative verb (e.g., “Kahn recommended”) or a phrase that starts with “it is” and contains *an adjective* (e.g., “It is important”)
- A subordinate clause in the subjunctive mood (usually beginning with the conjunction “that”)

Examples: *The present subjunctive:*

The doctor suggested that she rest.

Verbs in the present subjunctive do not follow subject-verb agreement. Instead, they take the infinitive form for all persons (e.g., “be,” “eat,” “sing”).

I propose that we take a short break.

It is advisable that the CEO resign.

*Note!*

*When the subject of a subjunctive verb is a personal pronoun, it's always a subject pronoun (e.g., “I,” “he,” “she,” “we”).*

*He insisted **me** sit down.*

*He insisted **I** sit down.*

## Negatives

Negative constructions using the present subjunctive are formed by adding the adverb “not” before the subjunctive verb.

Examples: *Negative present subjunctives:*

It's vital that we **not** miss our flight.

The artist asks that you **not** touch the paintings.

## The past subjunctive

The past subjunctive is typically used to refer to past or present actions or situations. Sentences in the past subjunctive mood contain two clauses:

- A main clause in the indicative mood (often containing the verb “wish”)
- A subordinate clause in the subjunctive mood (usually beginning with “that,” “if” or “as if”).

The past subjunctive form of the verb “be” is “were,” regardless of the subject (e.g., “I were,” “he were,” “she were”). All other verbs in the past subjunctive form are identical to their simple past tense forms (e.g., “I won”).

Examples: *The past subjunctive:*

Karla acts as if she were famous.

I wish I lived in New York.

When the past subjunctive form is used in an “if” clause, the main clause usually contains a modal verb (normally “would,” but sometimes “should,” “might,” or “could”).

Example: *Past subjunctive and modal verbs:*

If I were a millionaire, I **would** set up a charitable organization.

The subjunctive mood is sometimes confused with conditional sentences in the indicative mood because both commonly use dependent “if” clauses (conditional clauses) and refer to hypothetical situations.

However, while conditional clauses in the indicative mood are used to refer to actions or situations that are possible or likely, conditional clauses in the subjunctive mood refer to situations that are impossible or unlikely.

Examples: If I **were** you, I would buy a new car. [impossible scenario]

If he **was** late for work again, he probably got in trouble. [possible scenario]

*Note!*

In everyday speech and informal writing, “was” is sometimes used instead of “were” for the first- and third-person singular forms in subjunctive clauses (e.g., “If I was you”). However, this should be avoided in formal contexts such as academic writing.

**Common phrases in the subjunctive mood.** The subjunctive mood is also used in a range of expressions.

| Expression                                                 | Meaning                    |
|------------------------------------------------------------|----------------------------|
| <b>Be that as it may</b> , I’m not helping you move house. | Nevertheless               |
| You can borrow my car <b>if need be</b> .                  | If necessary               |
| <b>Suffice (it) to say</b> , it was the worst vacation.    | It is enough to say        |
| I’m here for you, <b>come what may</b> .                   | Regardless of what happens |
| If we have to cancel the surprise party, <b>so be it</b> . | I accept the situation     |

### Subjunctive Mood: Backshift

When using the subjunctive mood, **verbs** often *change form*. This process is commonly referred to as ‘**backshift**’. Here are the changes:

**Am/Is/Are → Be** You are confident. → I suggest that you be confident. (As you can see, ‘are’ in the declarative mood is changed to ‘be’ in the subjunctive mood.)

**has → have** She has an English degree. → I suggest she have an English degree. (‘Has’ in the declarative mood is changed to ‘have’ in the subjunctive mood.)

**was → were** I was happy. → I wish I were happy. (‘Was’ in the declarative mood is changed to ‘were’ in the subjunctive mood.)

**verbs in the 3rd person singular → the ‘-s’ is omitted** He exercises every day. → I suggest he exercise every day. (Here, the ‘-s’ in the 3rd person singular verb ‘exercises’ is omitted)

when it's used in the subjunctive mood.)

*Tip!*

*In informal English, "that" is commonly omitted from sentences with subjunctive mood.*

*It's important that they be prepared. → It's important they be prepared.*

**A list of some verbs that commonly need a subjunctive mood:** Suggest, demand, wish, recommend, order, command, insist, ask

E.g. Mike insisted that the price go higher. (Remember, in the subjunctive mood the verbs are not conjugated into third person singular form.)

Sarah demanded that she be free.

**A list of some adjectives that are commonly used in the subjunctive mood:** These adjectives are often used in "It is + adj + (that)" structure: important, necessary, essential, vital, crucial.

E.g. It is important that you be there.

It is essential that he listen to me.

*Tip!*

*In English, we normally do not encounter a negative subjunctive sentence. The subjunctive mood is usually used in an affirmative construction.*

*E.g. I suggest that he be early. (Not "I suggest that he not be late.")*

## **The Present Subjunctive**

He exercises every day. – I suggest he exercise every day

The present subjunctive form of a verb is the same as its base form. It is often used in formal English to indicate that something is important or suggested. Here are verbs and expressions that commonly use the present subjunctive mood:

*Adjectives:* important, necessary, essential, crucial ...

*Verbs:* suggest, recommend, demand, insist, ask ...

## **Present Subjunctive Mood: Other Ways**

If you prefer not to sound formal, you can use:

- the modal verb 'should' It's important that she be there. → She should be there.
- 'for + pronoun/object + to-infinitive' It's important that she be there. → It's important for her to be there.

## **The Past Subjunctive**

To discuss unreal or improbable situations in the present or future, we can use the past subjunctive. With the exception of the verb 'be', the past subjunctive form of all verbs is their past simple form. The past subjunctive form of 'be' is 'were' for all persons, regardless of whether the subject is singular or plural.

### **The past subjunctive is used with:**

Conditional type II sentences: E.g. If I were a parent, I would love my kid unconditionally. (Remember not to use 'was' for third and first person singular.)

'It's (about/high) time...' expression: E.g. It's about time you cleaned your room! (An expression used to emphasize that something should have occurred a long time ago.)

with the verb "Wish": E.g. I wish I were taller.

**Tip!**

When using the 'I wish...' structure to express a wish or desire, adding 'would' can convey a sense of annoyance or impatience with the current situation. Pay attention to the example:

E.g. I wish you wouldn't leave your clothes all over the floor. (Here, the man leaving your clothes all over the floor is 'annoying'.)

'If only' expressions: E.g. If only I knew her name.

'I'd rather' expressions: E.g. Well, I'd rather you didn't smoke in here. (Used to show that you prefer to have or do one thing more than another.)

'as if/as though' expressions: E.g. It's my birthday. As if/as though you didn't know! (They have a similar meaning and are used to talk about an imaginary situation or a situation that may not be true but is likely or possible. 'As if' is more common than 'as though'.)

**Tip!**

When discussing a situation that is probable or real, it is possible to use the present tense after "as if/though."  
E.g. It sounds as though you're having a great time. (In this case, we mean 'You are probably having a great time'.)

## Past Perfect Subjunctive

When discussing wishes in the past, it is common to use the past perfect tense. This tense is often used to describe hypothetical situations that did not actually occur.

E.g. I wish I had given you a chance. (By using the past perfect tense, the speaker can convey a sense of regret or desire for a different outcome in the past.)

## Review

In English grammar, mood is the way someone expresses a hypothetical situation, a wish, a demand, or a suggestion.

|                |                             |                                    |
|----------------|-----------------------------|------------------------------------|
| English Moods: | <i>the indicative mood</i>  | I called my sister yesterday.      |
|                | <i>the imperative mood</i>  | Answer the following questions.    |
|                | <i>the subjunctive mood</i> | If I were you, I would fight back. |

## Subjunctive Mood

The subjunctive mood indicates situations that are not real and are hypothetical. In addition to that, it expresses a suggestion, a necessity, importance, a possibility, a wish, or the way you want something to be.

## Present Subjunctive

am/is/are → be

You are confident. → I suggest that you be confident.

has → have

She has an English degree. → I suggest she have an English degree.

verbs in 3rd person singular → the '-s' is omitted

He exercises every day. → I suggest he exercise every day.

the modal verb 'should'

It's important that she be there. → She should be there.

for + pronoun/object + infinitive with to'

It's important that she be there. → It's important for her to be there.

### **Past Subjunctive**

was → were

conditional II type sentences

'It's (about/high) time...' expression

the verb 'Wish'

'if only' expression

'I'd rather' expression

'as if/though' expressions

I was happy. → I wish I were happy.

If I were a parent, I would love my kid unconditionally.

It's about time you cleaned your room!

I wish I were taller.

If only I knew her name.

Well, I'd rather you didn't smoke in here.

It's my birthday. As if you didn't know!

### **Grammar exercises:**

**Exercise 1. Read the following sentences and analyze the use of subjunctive II, translate the sentences into Ukrainian.**

1. He was the sort of man who worked magnificently, yet looked as if had never done a job at all (Essex)
2. Ann knew that inside her head it seemed as though the pendulum of some great clock swung to and from. (Essex)
3. There's something I want to tell you, things have been happening and it rather looks as if my life were taking a new shape. (Essex)
4. Lord Henry felt as if he could hear Basil Hallwar's heart beating, and wandered what was coming. (O. Wilde)
5. She was a curious woman, who's dressed always looked as if they had been designer in a rage and put on in a tempest. (O. Wilde)
6. The room looked as if it had not been lived in for years. (O. Wilde)
7. They (the eyes) were a paler blue than his father's as if they might have faded like the shirt. (F.O ``Connor``)
8. Mr. Errington was flattered to have such a pretty woman for company. One, who but for the ring and the just noticeable child she was carrying, looked as fresh as a girl, as if marriage had whisked over her so lightly that it had not broken the skin of her youth. (M. Bragg)

**Exercise 2. Read the sentences and analyse the use of Subjunctive II. Translate the sentences into Ukrainian.**

1. He said, "One day you must see my garden," but a little sadly, almost as if when he spoke of it, he knew it would never be. (Essex)
2. Ann helped the great man. He treated her as if she were a piece of furniture, and of as little consequence. (Essex)
3. He turned away as if he had never noticed her. (Essex)
4. He nodded, but almost as if he did not really see her. (Essex)

5. Miss Pettigow must be a nervous creature, in spite of her efficient sir, for she jumped as though she had been shot.

**Exercise 3. Insert the proper form of Subjunctive II.**

1. She just stood there as if she (not to mind)
2. Where are you running as if blood-hound (be) after you?
3. Why do you behave as if it (not to matter) in the least what we all thing of you?
4. Day after day we saw him leave the office as if nothing special (happen) to him.
5. He generally behaved as if he (do) nothing out of the way.

**Exercise 4. Supply the necessary forms for the verbs given in brackets.**

1. If I (to realize) it was to be like this, I (not to come). 2. If he (not to tell) us that himself I never (to believe) that. 3. He (to agree) never with you, even if he (be) wrong. 4. I (to be) grateful if you (to keep) the news to yourself. 5. If anyone (to ask) me what his specific gift was, I (not to know) how to answer. 6. She said she (to be) pleased if my mother (to allow) me to spend a month with them. 7. Mary is staying with them. I think it (to be) a good thing if you (to come) and (to see) her. 8. If we ever (to happen) to meet again I (to act) as if this letter never (to write).

**Exercise 5. Replace the infinitives in brackets by the correct form of the verb.**

1. If it (to be) all the same to me, I (not to come) and (to talk) with you. 2. If there (to be) some more of us, it (to take) only a few days to get through with it. 3. If anyone (to call), I shall give him the telephone number so that he (to get in touch) with you. 4. Leave a message for me if you (not to find) me in. 5. He (not to understand) it even if he (to be given) a broad hint which none other would miss. 6. If you (to come across) an expression that you do not know, write it out, please. 7. You (not to find) the house even if you (to ask) for directions: it has been pulled down recently.

**Exercise 6. Supply the necessary forms for the verbs given in brackets in the following conditional sentences referring to the future.**

1. If Ed (to learn) about it, he probably never (to speak) to me again. 2. I (to be) in the drawing-room in case there (to be) a telephone call for me. 3. He wondered how he (to feel) if his former wife (to come) into the room. 4. Philip says they (to miss) me if I (to leave) before their wedding. 5. In case any crisis (to arise), let me know. 6. You (to do) it differently, if you (have to do) it over again? 7. If this (to be) our last meeting for some time, I (not to like) you to

remember this talk. 8. It (to be) awkward if she (to refuse) to co-operate. 9. What his mother and father (to think) if they (to hear) of what he has done? 10. If the situation (not to change) by Saturday I (to be) in trouble. 11. I (not to be) surprised if he (to offer) an important post under the next government.

**Exercise 7. Practise the following according to the models.**

*Model 1: A. I know five languages.*

*B. I wish I knew five languages, (stress on the second "I")*

*Or: B. If only I knew five languages! (this form is much more dramatic and less generally useful than the "I wish" form)*

1. I have a flat here.
2. I live near my work.
3. I have plenty of time for reading.
4. I understand it.
5. My son writes every week.
6. My house looks out on a park.
7. I can take a day off any time.

*Model 2: A. I asked Bill.*

*B. I wish you'd asked Tom too.*

*Or: B. If only you'd asked Tom too. ("had" is normally contracted here)*

1. I invited Paul.
2. I stopped Mary.
3. I rang Ann.
4. I wrote to Alex.
5. I spoke to John.
6. I warned Philip.
7. I voted for Peter.

*Model 3: Take more care. - / wish you would take more care.*

*Don't shout at me. - / wish you wouldn't shout at me.*

1. Don't throw rubbish on the floor.
2. Listen to me.
3. Don't waste so much time.
4. Try to answer my questions.
5. Get up earlier.
6. Don't be so impatient.
7. Look where you are going.
8. Speak more clearly.
9. Don't open the windows.
10. Don't walk so fast.
11. Write more carefully.
12. Don't come into the room without knocking.
13. Help me to move this cupboard.

14. Keep quiet.

**Exercise 8.** Add to each of the following a sentence, beginning: “*I wish...*”. The words in brackets will help you to form your sentences.

1. We lost the game yesterday, (win) 2. I sat at the back of the hall, and couldn't hear his speech very well, (every word) 3. The sea is rough, we can't sail to the island, (calm) 4. There were no taxis, so I had to walk from the station, (find) 5. I went to bed very late last night, and I'm half asleep this morning, (so late) 6. I could only answer three of the questions at the last examination, (all of them) 7. The box was heavy; I couldn't carry it. (help me) 8. My father gave me some good advice, but I didn't take it. (his advice) 9. One of my friends went to London for a holiday last summer, but I couldn't go. (with him) 10. Why didn't you watch the cat? It ate all the fish. I'm so angry with you. (more attentive) 11. There was so much noise in the streets last night that I couldn't sleep well, (better) 12. There was a very good film on last week, but I didn't see it. (read the program) 13. We went for a picnic yesterday, but it rained all the time, (so hard) 14. I was lazy and wasted my time when I was at school, (harder) 15. I didn't understand what he said yesterday (louder) 16. This house is very nice and comfortable. I'd like to buy it, but it is very expensive, (less expensive)

**Exercise 9.** Rewrite the following, using a “*wish*” construction (phrases in brackets should be omitted).

1. I'm sorry I don't live near my work. *I wish I lived near my work.*
2. I'm sorry I don't know Finnish.
3. I'm sorry I didn't book a seat.
4. I'm sorry I can't drive.
5. I'd like you to keep quiet. (You are making so much noise that I can't think.)
6. It's a pity he didn't work harder during the term.
7. I'm sorry you didn't see it.
8. It's a pity you are going tonight.
9. I'd like you to wait for me (even though you are ready to start now).
10. I'm sorry I didn't bring a map.
11. I'm sorry I didn't know you were coming.
12. I'm sorry I can't swim.
13. I'm sorry you aren't coming with us.

**Exercise 10.** Memorize the following proverbs. Explain their meaning and give Ukrainian equivalents to them.

1. If it rains at eleven, it will last till seven.
2. If an ass brays you, you don't bray him.
3. If the sky falls, we shall catch larks.
4. If we can't as we would, we must do as we can.

5. If you agree to carry the calf, they'll make you carry the cow.
6. If you cannot have the best, make the best of what you can.
7. If you laugh before breakfast, you'll cry before supper.
8. If you want a thing done, do it yourself.
9. If the cap fits, wear it.
10. If the blind lead the blind, both shall fall into the ditch.
11. If the mountain will not come to Mahomet, Mahomet must go to the mountain.
12. If you pay not the servant his wages, he will pay himself.
13. If you run after two hares, you'll catch none.
14. If you sell the cow, you will sell her milk too.

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Навчальне електронне видання

Куделіна Ольга Юріївна  
Соборова Ольга Михайлівна  
Мітіна Олена Михайлівна

**НАВЧАЛЬНИЙ ПОСІБНИК**  
з англійської мови  
для магістрів I року II семестру  
денної форми навчання  
(спеціальність – 207 Водні біоресурси та аквакультура)

Навчальний посібник  
(українською та англійською мовами)

**Видавець і виготовлювач**  
Одеський державний екологічний університет  
вул. Львівська, 15, м. Одеса, 65016  
тел./факс: (0482) 32-67-35  
E-mail: [info@odeku.edu.ua](mailto:info@odeku.edu.ua)