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(ДРТИ ФГБОУ ВО «АГТУ»)

Система менеджмента качества в области образования, воспитания, науки и инноваций сертифицирована DQS
по международному стандарту ISO 9001:2015

Факультет высшего образования

Кафедра «Гуманитарные и социально-экономические дисциплины»

ИНОСТРАННЫЙ ЯЗЫК В ПРОФЕССИОНАЛЬНОЙ СФЕРЕ

Методические указания

по выполнению самостоятельной работы

для обучающихся по направлению подготовки,

35.04.07 Водные биоресурсы и аквакультура

Направленность «Управление водными биоресурсами»

п. Рыбное, Дмитровский р-н, Московская обл. – 2022

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Методические рекомендации по выполнению самостоятельной работы по дисциплине предназначены для обучающихся по направлению 35.04.07 Водные биоресурсы и аквакультура, направленность «Управление водными биоресурсами». Цель методических указаний: оказание помощи обучающимся в выполнении самостоятельной работы по дисциплине. Настоящие методические указания содержат работы, которые позволят обучающимся самостоятельно овладеть фундаментальными знаниями, профессиональными умениями и навыками деятельности.

Методические рекомендации по выполнению самостоятельной работы по дисциплине утверждены на заседании кафедры «Гуманитарные и социально-экономические дисциплины» «25» мая 2022 г., протокол №5.

Методические рекомендации по выполнению самостоятельной работы по дисциплине «*Иностранный язык в профессиональной сфере*» предназначены для обучающихся по *направленности 35.04.07 Водные биоресурсы и аквакультура Направленность "Управление водными биоресурсами"*

Цель методических указаний: оказание помощи обучающимся в выполнении самостоятельной работы по дисциплине «*Иностранный язык в профессиональной сфере»*

Настоящие методические указания содержат работы, которые позволят обучающимся самостоятельно овладеть знаниями, умениями, навыками, *опытом практической деятельности* и направлены на формирование следующих компетенций:

УК-4	Способен применять современные коммуникативные технологии, в том числе на иностранном(ых) языке(ах), для академического и профессионального взаимодействия

В результате выполнения самостоятельных работ по дисциплины «*Иностранный язык в профессиональной сфере*» обучающиеся должны:

- знать:

правила и закономерности личной и деловой устной и письменной коммуникации; - современные коммуникативные технологии на русском и иностранном языках; существующие профессиональные сообщества для профессионального взаимодействия (УК-4.1)

- уметь:

применять на практике коммуникативные технологии, методы и способы делового общения для академического и профессионального взаимодействия (УК-4.2)

- владеть навыками и (или) иметь опыт:

методикой межличностного делового общения на русском и иностранном языках, с применением профессиональных языковых форм, средств и современных коммуникативных технологий и (УК-4.3)

1. Тематика и задания самостоятельной работы

Темы самостоятельных работ совпадают с названиями разделов дисциплины «*Иностранный язык в профессиональной сфере*» и формируются с указанием цели самостоятельной работы, задания, порядка выполнения работы, формы контроля, требований к выполнению и оформлению заданий. Указанные виды аудиторной и внеаудиторной самостоятельной работы по дисциплине (модулю) соответствуют заявленным в рабочей программе по данной дисциплине (модулю).

1.1. Тема: **подготовка к тестированию.**

Задание: Решить тест (лексико-грамматический).

Чтение и перевод текстовых материалов по изучаемой теме, подготовка к практическим занятиям; поиск дополнительной информации в Интернет-источниках: подготовка к опросу: составление монологического высказывания по темам.

Содержание тестового задания ориентировано на получение однозначного ответа (заключения). Предлагаются тесты репродуктивного (подстановочного) характера, в котором намеренно пропущено слово, и тест с продуктивным заданием, требующим знания-умения, касающегося грамматических структур изучаемого иностранного языка. Тесты по каждой теме составлены с учетом усвоенного в ходе изучения этой темы материала.

Требования к выполнению данного задания:

На выполнения всего теста дается определенное время: на решение индивидуального теста, состоящего из 8 заданий, отводится 30 мин. Тест считается успешно выполненным в том случае, если он оценивается в 8 и более баллов (по 1 баллу за каждый верный ответ на закрытые задания и максимум 5 баллов за полный ответ на открытые задания). Тест выполняется на индивидуальных бланках, выдаваемых преподавателем, и сдается ему на проверку, либо на образовательном портале

Порядок выполнения задания:

Тесты составлены с учетом лекционных материалов по каждой теме дисциплины (модуля). Для подготовки к тестам необходимо изучить материал по каждой теме дисциплины, необходимо понять логику изложенного материала.

- При решении тестов необходимо выполнить следующее

1. Внимательно изучите структуру теста, оцените объем времени, выделяемого на данный тест, поймите, какого типа задания в нем содержатся.

2. Заполните пропуски, выбрав один из предложенных вариантов. Если вы не знаете ответа на вопрос или не уверены в правильности, следует пропустить его и отметить, чтобы потом к нему вернуться.

3. Изменить грамматическую структуру предложения, произведя сопутствующие замены на уровне лексики и грамматических категорий.

3. Многие задания можно быстрее решить, если не искать сразу правильный вариант ответа, а последовательно исключать те, которые явно не подходят. Метод исключения позволяет в итоге сконцентрировать внимание на одном-двух вероятных вариантах.

4. Рассчитывать выполнение заданий нужно всегда так, чтобы осталось время на проверку и доработку (примерно 1/3-1/4 запланированного времени). Тогда вероятность описок сводится к нулю и имеется время, чтобы набрать максимум баллов на легких заданиях и сосредоточиться на решении более трудных, которые вначале пришлось пропустить.

5. Процесс угадывания правильных ответов желательно свести к минимуму.

Форма контроля– количество правильно решенных тестовых заданий

Требования к оформлению задания:

Ответы на тест должны быть представлены на образовательном портале. (Образцы типовых тестов к указанным темам приводится в ФОС к Рабочей программе.)

Рекомендуемые источники (см. в Рабочей программе список литературы, рекомендуемой по данной теме, и список информационных ресурсов.)

1.2. Тема: подготовка к опросу-квизу (контроль)

Задание: подготовка кратких или развернутых ответов на предложенные вопросы по изучаемой теме.

Чтение и перевод учебных текстов по изучаемой теме; поиск дополнительной информации в Интернет-источниках: подготовка к фронтальному опросу. Подготовка к тесту.

Устный опрос необходим для проверки знания языкового материала и умения употреблять его для составления речевых высказываний с целью раскрыть содержание изучаемой темы, описать суть явлений. Проводится в форме фронтального, индивидуального или комбинированного опроса, при котором сначала задается вопрос, а затем называется фамилия или имя студента, которому предлагается ответить на вопрос. Фронтальный опрос проводится в высоком темпе. Отдельные вопросы предлагается подробнее раскрыть в индивидуальных ответах. Преподаватель может проводить комбинированный опрос.

Требования к выполнению данного задания:

1. Повторить лексический и грамматический материал соответствующих разделов учебника и учебных пособий по данной теме.

2. Определить основные проблемы и факты, связанные с содержанием изучаемой темы, по которым могут быть заданы вопросы.

3. Просмотреть дополнительные источники информации по изучаемой теме, в том числе Интернет-источники.

Порядок выполнения задания:

1. Прослушать вопрос и дать на него краткий или развернутый ответ, в зависимости от типа опроса.
2. Внимательно прослушать ответ другого студента и сделать заметки, касающиеся неточной или пропущенной информации (фактов).
3. Сделать сообщение, дополняющее информацию, представленную другими студентами.

Требования к оформлению задания:

Ответы на тест должны быть представлены на образовательном портале. (Образцы типовых тестов к указанным темам приводится в ФОС к Рабочей программе.)

Рекомендуемые источники (см. в Рабочей программе список литературы, рекомендуемой по данной теме, и список информационных ресурсов.)

Рекомендуемые источники (см. в Рабочей программе список основной и дополнительной литературы, рекомендуемой по соответствующей теме, и ссылки на рекомендуемые Интернет-источники, информационные ресурсы.)

1.3. Тема: Подготовка к проигрыванию ситуаций.

Задание: проигрывание ситуаций.

Контрольная работа – самостоятельная письменная аналитическая работа (проигрывание ситуаций).

Требования к выполнению данного задания:

При подготовке контрольной работы основным выступает творческий подход, умение обрабатывать и анализировать информацию, делать самостоятельные выводы, обосновывать целесообразность и эффективность предлагаемых рекомендаций и решений проблем, чётко и логично излагать свои мысли. Подготовку контрольной работы следует начинать с повторения соответствующего раздела учебника, учебных пособий по данной теме, анализа дополнительных источников информации по изучаемой теме и изучаемому иностранному языку.

Порядок выполнения задания:

1. Проанализировать содержательную составляющую изучаемой темы.
2. Ознакомиться со списком предлагаемых для контроля лексических единиц, словосочетаний, языковых и речевых клише, грамматических конструкций, и их русскоязычными эквивалентами.
3. Проанализировать включенные в контрольные задания предложения и продумать средства и приемы выполнения контрольного задания (перевод русского текста на английский язык).

4. Выполнить необходимое действие (перевод.), определяемое заданием контрольной работы.

Форма контроля – заслушивание выполненного задания на аудиторном занятии.

Требования к оформлению задания:

Ответы на тест должны быть представлены на образовательном портале. (Образцы типовых тестов к указанным темам приводится в ФОС к Рабочей программе.)

Рекомендуемые источники (см. в Рабочей программе список литературы, рекомендуемой по данной теме, и список информационных ресурсов.)

1.4. Тема: подготовка к участию в дискуссии.

Задание: подготовить ответы на вопросы дискуссии или аргументацию своей позиции по обсуждаемой теме дискуссии.

Дискуссия заключается в коллективном обсуждении вопросов, проблем, или сопоставление информации, идей, предложений.

Тема РП № 3: Специальная тема: «Проблема сохранения и защиты рыбных запасов»; общекультурная тема: «Достижения в жизни и профессии».

Темы, выносимые на обсуждение:

1. Мировые рыбные запасы неисчерпаемы/ Рыбные запасы мировых морей и океанов находятся в опасности.

2. Для сохранения осетровых в Нижневолжском бассейне достаточно борьбы с браконьерством / Необходимо восстанавливать запасы осетровых в Нижневолжском бассейне путем развития аквакультуры и применения современных методов воспроизводства.

Требования к выполнению данного задания:

Необходимо заранее ознакомиться с темами и проблемами, выносимыми на дискуссию. Затем изучается учебная литература, анализируются дополнительные источники информации по этой тематике, ищутся ответы на вопросы, подбирается аргументация своей точки зрения, фактические сведения. Необходимо пользоваться такими основными источниками информации как: учебники библиотеки университета, ЭБС университета. Можно обращаться к научным работам и трудам известных ученых, периодическим специальным или массовым изданиям. Работая с литературой по заданной теме, необходимо уметь выделять главные моменты в материале, для чего провести конспектирование материала и подготовить план выступления на дискуссии. Следует повторить языковые и речевые клише, правила речевого этикета.

Порядок выполнения задания:

1. Ознакомиться с темой или проблемой, выносимой на обсуждение, вопросами по теме дискуссии.
2. Изучить рекомендованную литературу и провести конспектирование важнейших источников.
3. Подготовить конспект выступления на дискуссии, аргументацию выражаемой точки зрения, вопросы предполагаемым оппонентам.

Форма контроля - качество выступления обучающихся, умение обосновать защищаемую точку зрения, глубину и логичность ответов на вопросы по теме, обсуждаемой на дискуссии.

Требования к оформлению задания:

Ответы на тест должны быть представлены на образовательном портале. (Образцы типовых тестов к указанным темам приводится в ФОС к Рабочей программе.)

Рекомендуемые источники (см. в Рабочей программе список литературы, рекомендуемой по данной теме, и список информационных ресурсов.)

1.5. Тема: подготовка эссе

Задание – составить эссе на тему:

Специальная тема: «Научный подход к объекту исследования»; общекультурная тема: «Открытия и изобретения».

Эссе – сочинение небольшого объема и свободной композиции, выражающее индивидуальную позицию автора по конкретному поводу или общественно-значимой проблеме.

Требования к выполнению данного задания:

Текст должен содержать:

- Вводную часть: значение исследуемых научных фактов в теории и практике.
- Основную часть: анализ и обобщение материала, разъяснение собственной позиции.
- Выводы и рекомендации. Работа обязательно должна содержать в себе ответы на вопросы, поставленные вводной частью, демонстрировать конкретные выводы.

Порядок выполнения задания:

- составить план эссе;
- подобрать и изучить источники по теме, содержащуюся в них информацию;
- систематизировать и проанализировать собранную информацию по

проблеме;

- лаконично, но емко раскрыть содержание темы, заявленной в эссе, и свои взгляды на нее;
- оформить эссе и сдать в установленный срок.

Структура эссе:

1. Титульный лист/тема эссе.
2. План (в случае большого объема эссе).
3. Введение.
4. Основная часть.
5. Заключение.
6. Список использованной литературы.

Форма контроля: оценка подготовленного обучающимся эссе.

Требования к оформлению задания:

Ответы на тест должны быть представлены на образовательном портале. (Образцы типовых тестов к указанным темам приводится в ФОС к Рабочей программе.)

Рекомендуемые источники (см. в Рабочей программе список литературы, рекомендуемой по данной теме, и список информационных ресурсов.)

Примеры самостоятельной работы:

Задание для CPC_1.

Прочтите дополнительный текст **FISH IN WATER-BASED ECOSYSTEMS** и выполните послетекстовые задания.

На основании полученной информации переведите на английский язык приведенные ниже предложения, используя усвоенную иноязычную терминологию.

1. Экосистема Нижней Волги (the Volga River lower) уникальна и разнообразна благодаря особенностям климата и меняющейся солености воды.

2. Флора региона насчитывает около 1500 видов растений, из которых 24 вида являются редкими.

3. Каспийское море и дельта Волги известны запасами ценной промысловой рыбы, состояние которых в последнее время ухудшается из-за влияния человеческого фактора.

4. Многие виды рыб не могут адаптироваться к повышающейся солености воды в нижней части Волги и мигрируют выше по течению.

5. Ухудшение условий обитания эндемических видов Каспийского моря может быть связано с появлением конкурирующих внедряющихся видов.

FISH IN WATER-BASED ECOSYSTEMS

Exercise 1. Read and understand the text.

Composition of aquatic ecosystems

It is a well-known fact that fishes can be found practically in all major aquatic habitats: lakes, big and small rivers, ice-covered oceans, tropical seas, ponds, etc. Together with other aquatic inhabitants they form aquatic ecosystems in which they are considered a dominant component. Aquatic biodiversity varies from region to region, and it is essential to the functioning of ecosystems. The greatest biodiversity is found in tropical latitudes with their estimated 3,000 species of fish and 4,000 species of mollusks. Unique aquatic groups are more typical of fresh-water habitats due to the fact that they are often isolated from one another by natural barriers. Nonetheless, Antarctic habitats also support such unique aquatic groups as the albatross, penguin, and large marine mammals: whale and seal. Species in the ecosystem perform different or overlapping functions and their interactions may even be restricted only to those of the food webs.

To survive in a variety of environments fishes have evolved all kinds of adaptations: anatomical, physiological, behavioral, and ecological. Genetic variation also allows species to adapt to changing habitat. Examples are numerous. Some Arctic fishes have no hemoglobin. Many deep-sea forms can swallow prey larger than themselves. Others have modified their body parts to attract prey, some species significantly change the shape of their bodies to deter predators, or even produce large amounts of high-voltage electricity for this purpose. Pelagic shark and tunas have

circulatory systems designed to maintain their body temperatures higher than their surroundings. Gender change is common among fishes. It is also not unusual that fishes grow and change their ecological role several times throughout their lives.

Coral reefs, ocean depths, mountain rivers, estuaries and other types of water-based ecosystems are particularly fragile. The loss of a single species can have profound effects for the ecosystem as a whole. Habitats with little diversity generally suffer most as a disturbance of one species may cause the collapse of the entire network of interactions. The deterioration of biota habitat can be caused by such natural phenomena like earthquakes, floods, draught. Aquatic biodiversity is threatened by human activities as well. These may result in pollution of habitats from industry effluents, agriculture use of fertilizers or pesticides. Building of dams and marshy areas drainage destroys many river ecosystems. Overfishing is the largest threat to biodiversity in rivers, seas and oceans. Thus, to preserve aquatic biodiversity it is necessary to keep water-based ecosystems and their environment intact.

Exercise 2. Comprehension. Answer the questions.

1. What component is considered dominating in aquatic ecosystems?
2. In which areas is aquatic biodiversity the greatest?
3. Why are unique aquatic groups more typical of fresh-water habitats?
4. Which unique aquatic groups can be found in Arctic habitats?
5. How can the interaction of different species in an ecosystem be characterized?
6. What helps fishes to survive in a variety of environments?
7. Which modification is common among fishes?
8. Why is a loss of a single species harmful for the ecosystem?
9. What are the natural causes of an ecosystem deterioration?
10. How can human activity destroy an aquatic biodiversity?

Exercise 3. Match words in **A** and **B**.

A. Моллюск, место обитания, добыча, гемоглобин, наводнение, акула, биота, избыточный вылов, пресноводный, морские млекопитающие, вид, кровеносная система, биоразнообразие, хищник, гендер (пол), разрушать, кит, хрупкий, мидия, пищевая цепь, тропические широты, форма тела.

B. Biodiversity, habitat, gender, marine mammals, species, food web, whale, prey, predator, mussel, tropical latitudes, mollusk, fresh-water, flood, circulatory system, destroy, shape of the body, fragile, hemoglobin, shark, biota, overfishing.

Exercise 4. Find definitions to the following words:

plankton, marine mammals, flowing-water habitat, salinity, biodiversity, variation, pelagic organisms, deep-sea forms, predators, inhabitant.

1. Changes in biological organisms caused by changes in their environment.

2. Tiny biological organisms that float along with currents and provide food for fish and whales.

3. What is understood as the variety of biological organisms in a given area, habitat, or ecosystem.

4. Benthic species living on the ocean bootom.

5. Aquatic habitats characterized by water currents.

6. Biological organisms (e.g. animals) that kill other biological organisms (prey) in order to survive.

7. A biological organism that lives in a particular place.

8. The mass of grams of dissolved inorganic matter in water or soils (concentrations expressed in $^{0}/_{00}$; PSU).

9. Aquatic organisms living in water column.

10. Aquatic mammals that constitute an element of ocean or aquatic ecosystems.

Exercise 5. Fill in the blanks with appropriate words and word combinations given in italics:

adaptations, supports, temperatures, fishing, biota, fertilizers, prey, fresh-water, species, mammals.

1. The book describes the number of different … of plants and animals within the wetlands area.

2. Unlike oceans, … habitats often are isolated from one another.

3. ... and diversity are interwoven throughout the evolutionary history of fishes.

4. The Great Barrier Reef, off the coast of Australia, … over 700 species of coral.

5. Many fishes in the Antarctic Ocean possesss special molecular propertires to deal with the cold water … .

6. Some sharks have a placental structure as complex as any found in … .

7. Predatory tactics include attracting … with modified body parts.

8. Living organisms, i.e. … have scientific and educational value.

9. Agricultural runoff may contain residues of … or pesticides.

10. … is a powerful evolutionary force which can affect population structure.

Exercise 6. Complete the sentences and translate them.

1. Biodiversity describes …

2. Gender variation allows species …

3. Natural barriers in fresh-water habitats result …

4. Scientists have shown that habitats with greater biodiversity …

5. Preservation of large, intact areas of habitat is necessary …

6. Extensive fossil record proved that fishes are excellent …
7. The intertidal zone has the greatest density of living organisms …

a. in the evolution of distinct species.
b. are better able to recover from various disturbances.
c. the variety of biological organisms in a given habitat, or ecosystem.
d. showcases of the evolutionary process.
e. among marine environments.
f. for the continued function of ecosystems.
g. to adapt to changes in their environment.

Exercise 7. Change Russian words for their English equivalents. Read and translate the text.

Biodiversity of the Caspian Sea habitat

The biodiversity of the Caspian Sea is poor, probably, due to the variable salinity. For (пресноводный) fauna and flora the salinity levels of the Caspian Sea is too high, and for (морские виды) the salinity is too low. Thus, the modern Caspian Sea is only suitable for species (адаптировавшийся) to slightly saline waters. Despite these particular salinity (условия), the Caspian Sea is home to 87 species of microphytes and many species of green algae.

The Caspian Sea was isolated from other (океаны) thousands of years ago which resulted in the extreme variety of biotopes as well as biotic and abiotic conditions. There also has developed distinctive species of ichthyofauna endemic to the Caspian Sea. The only endemic (млекопитающее) in the Caspian Sea is the Caspian (тюлень) (*Phoca caspica*).

The greatest variety of inhabitants in the Caspian Sea is within (рыба) and crustaceous species. These species, along with species of protozoa, invertebrates, vertebrates and parasitic organisms have developed good osmoregulatory (способности), so they are capable of living in a very wide range of salinities.

However, the important feature of the present day fauna and flora of the Caspian Sea is a large number of introduced species to which endemic species are often poor competitors. These organisms are of different (происхождение): Arctic, Atlantic, Meditteranean. But some species originated from the Caspian Sea have also been introduced into different (экосистемы). The example is 'zebra (мидии)' (*Dreissena polymorpha*) which were introduced into Europe and later to the Americas during the 19th Century. It is a well-known fact that introduced species can cause (экологический) imbalances within the new ecosystem which may lead to further environmental problems.

Exercise 8. Read the text and answer the questions in each passage.

THE INFLUENCE OF CLIMATE CHANGE ON WATER-BASED ECOSYSTEMS

1. What kind of problems does the deterioration of aquatic organism habitat cause?

Water-based ecosystems are particularly vulnerable to climate change, as they experience its direct influence. The threats of the climate change to aquatic habitats include changes in water temperature, location and timing of ocean currents, increased precipitations causing changes in estuaries and rising sea level, more frequent and extreme storms which imperil habitats, etc. Droughts can cause changes in lake water levels and river flows. The deterioration of aquatic organism habitat causes not only environmental problems. It can as well threaten human communities dependent on fisheries and aquaculture, reducing the global fish supply for consumption.

2. How can local ecosystems alter in fish stock?

When the sea surface temperature rises, there frequently observed harmful algae blooming. As a consequence, the level of dissolved oxygen in water decreases, plankton composition changes, fouling organisms such as parasites and pests cause incidence of diseases. Local ecosystems are altered in the composition and abundance of fish stock as to competitors, predators and invasive species. Changes in location and size of suitable range for particular species are followed by changes in timing and success of migrations and spawning. Higher sea temperature is a major cause of coral bleaching and damage to coral reef ecosystems, especially to breeding habitats, around the globe.

3. What are the causes of wild fish stock depletion?

Rising sea level can damage and destroy many coastal ecosystems such as mangroves and salt marshes, which are essential to maintaining wild fish stock. Availability of wild fish will also be harmed by higher inland water temperatures and worsening water quality. Inland temperature changes provide favourable conditions for bringing new pathogens and predators. The abundance of food available to fishery species decreases reducing fish growth and potential yields. It even can lead to the loss of some species. It should be noted that ocean currents altering their location and timing can account for nutrient supply in surface waters and, consequently, wild fish stock productivity.

4. Why is the predicted global warming considered a threat to aquatic organisms?

Increase in frequency and intensity of storms and draughts cause changes in water salinity and water quality which may lead to the loss of wild and cultured stock. Changes in precipitation and water availability can force some species to migrate. This can result in altered distribution, composition and abundance of fish stock. Under the scenario of 2 - 6º C global warming, precipitation is forecast to decline in South-Asian regions during the dry season and increase during the wet season, expanding flood-prone areas by 23-39%. It might reduce spawning success of river fishes due to higher wet season river flows and fish survival in lower dry season flows. Human responses, like hydraulic engineering projects, can lead to the loss of habitat for many aquatic organisms, fish species included.

Exercise 9. Translate into English.

1. Экосистема Нижней Волги (the Volga River lower) уникальна и разнообразна благодаря особенностям климата и меняющейся солености воды.

2. Флора региона насчитывает около 1500 видов растений, из которых 24 вида являются редкими.

3. Каспийское море и дельта Волги известны запасами ценной промысловой рыбы, состояние которых в последнее время ухудшается из-за влияния человеческого фактора.

4. Многие виды рыб не могут адаптироваться к повышающейся солености воды в нижней части Волги и мигрируют выше по течению.

5. Ухудшение условий обитания эндемических видов Каспийского моря может быть связано с появлением конкурирующих внедряющихся видов.

Exercise 10. Discuss with your group-mates possible threats to the ecosystems of your region.

Задание для СРС_2.

Exercise 7. Change Russian words for their English equivalents. Read and translate the text.

Feeding adaptations in fishes

Limited light and vast spaces mean that food is rather scarce in the deep sea. All marine (пищевая цепочка) originate in the euphotic zone, which makes up about 3% of the ocean. All deepsea fishes are carnivorous, feeding either on (зоопланктон), larger invertebrates, or other fish. Food scarcity makes both saving and obtaining (энергия) the first-rate task, thus deepsea fishes show a number of convergent foraging characteristics.

Feeding involves biting, sucking, chewing, and swallowing. These processes are even reflected in the names of some species, such as gulpers, swallowers. All fish feeding on plankton have a small (рот) and numerous fine (жабры) rakers, whereas (хищники) on larger animals have larger mouths and fewer gill rakers, hinged (челюсти) and (растяжимые желудки). Fishes searching food in water column rely mainly on (зрение).

Chemoreceptors, touch, (вкус и запах) are used by species that possess barbells, such as sturgeons or cods. They move along the bottom probing into sediments with their muscular barbels. Most fish that feed on (моллюски) or echinoderms crush the shell in the mouth, using molarlike (зубы), which may be located deep in the (глотка). Final handling of food occurs as chemical breakdown in the stomach and (кишечник).

Many deepsea fishes undertake evening and dawn migrations in the water column exploiting surface currents that bring new food. Others stay relatively motionless luring prey by bioluminescent colouring, which minimize their (метаболический) activity. The level of generated (ферменты) in such species are lower than in their shallow water relatives. There are also structural changes in bones and muscles which make the mass of fish closer to neutral (плавучесть).

Exercise 7. Read the text and answer the questions in each passage.

- **STAGES OF FISH'S LIFE**
- **1. What are the stages of fish's life?**
- Fish grow and change throughout their lives, i.e. they undergo several transitional stages. Eggs, larvae, juveniles, growth and aging are followed by changes in the organ systems of fish. There are two important events in the early life of a fish: the first one is hatching or birth, and the second event is the onset of exogenous feeding. Though eggs and larvae are considered the most vulnerable stages during the life history of an individual, some fishes are known for their postreproductive period when the degeneration of a fish's organs cause death.
- **2. How is the free-swimming larvae with a yolk sack called?**

- Ichthyologists consider that larval stage begins as soon as the fish hatches from the egg. For larvae the yolk serves as a food source till the transition to plankton as forage. The young may be free-swimming and still have a large yolk sac. In this case it is termed “a free embryo”, or “yolk-sack larvae”. The term “fry” is used for advanced larvae at the stage when the yolk is absorbed and the fish becomes dependent on other food sources, or for early juveniles. When larvae that initially occupy a nest become capable of swimming above the nest, they reach a swim-up stage. In general, the larval stage continues until development of the axial skeleton, fins, and organ systems is complete.
-

- **3. Why is it necessary for juveniles to store sufficient energy during their first summer?**
- The juvenile phase is characterised by the full development of axial skeleton, all organ systems, pigmentation, and fins. In fact, at this time fish looks like a miniature adult. This transition can be brief and relatively simple (minutes or hours) in some species, or can require several weeks and be very complicated in others. The juvenile stage is characterized by selection of food acquisition and formation of abilities to avoid predators. The chief task of fish at this stage is to acquire sufficient energy store during summer to survive in their first winter period. To acquire enough energy and to grow, they must be able to establish and defend their feeding territory.
-

4. Which factors influence fish growth and aging?

Age is generally correlated with size, although sufficient variation in size at any particular age exists in most species. While a fish grows, scales which begin to develop during the larval stage also grow and give a record of fish age in years. Fish growth typically slows down when they enter spawning condition, as energy is allocated away from growth to the gamete production and reproductive behavior. A decrease in feeding also results in slowing down fish growth. As a fish ages, the balance between such functions as feeding, locomotion, and predator avoidance shift. While juveniles mainly exhibit locomotory and defensive traits, adults of the same species maximize their feeding performance. Fish growing and aging highly depend on the conditions of habitat and their changes which take place during an animal’s life cycle.

SOME FACTS ABOUT FISH PHYSIOLOGY

In fish, food is ingested through the mouth and then broken down in the esophagus. When it enters the stomach, the food is further broken down and, in many fish, further processed in fingerlike pouches called pyloric caeca. The pyloric caeca secrete digestive enzymes and absorb nutrients from the digested food. Organs such as

the liver and pancreas add enzymes and various digestive chemicals as the food moves through the digestive tract. The intestine completes the process of digestion and nutrient absorption.

- Most fish exchange gases by using gills that are located on either side of the pharynx. Gills are made up of threadlike structures called filaments. Each filament contains a network of capillaries that allow a large surface area for the exchange of oxygen and carbon dioxide. Fish exchange gases by pulling oxygen-rich water through their mouths and pumping it over their gill filaments. The blood in the capillaries flows in the opposite direction to the water, causing counter current exchange. They then push the oxygen-poor water out through openings in the sides of the pharynx.

Fish typically have quite small brains relative to body size when compared with other vertebrates, typically one-fifteenth the mass of the brain from a similarly sized bird or mammal. However, some fishes have relatively large brains. The brain is divided into several regions. At the front are the olfactory lobes which are very large in fishes that hunt primarily by smell, such as hagfish, sharks, and catfish. Behind the olfactory lobes is the two-lobed telencephalon, the equivalent structure to the cerebrum in higher vertebrates. In fishes the telencephalon is concerned mostly with olfaction. Together these structures form the forebrain. Connecting the forebrain to the midbrain is the diencephalon. It performs a number of functions associated with hormones and homeostasis. The pineal body lies just above the diencephalon. This structure performs many different functions including detecting light, maintaining circadian rhythms, and controlling colour changes.

The midbrain or mesencephalon contains the two optic lobes. These are very large in species that hunt by sight, such as rainbow trout and cichlids.The hindbrain or metencephalon is particularly involved in swimming and balance. The cerebellum is a single-lobed structure that is usually very large, typically the biggest part of the brain. The brain stem or myelencephalon is the most posterior part of the brain. As well as controlling the functions of some of the muscles and body organs, in bony fish at least the brain stem is also concerned with respiration and osmoregulation.

Most fish possess highly developed sense organs. Nearly all daylight fish have well-developed eyes that have color vision that is at least as good as a human's. Many fish also have specialized cells known as chemoreceptors that are responsible for extraordinary senses of taste and smell. Although they have ears in their heads, many fish may not hear sounds very well. However, most fishes have sensitive receptors that form the lateral line system. The lateral line system allows for many fish to detect gentle currents and vibrations, as well as to sense the motion of other nearby fish and prey.

FISH ANATOMY

Exercise 1. Read and understand the text.

Fish basic anatomy

The knowledge of basic anatomy is fundamental to appreciating fish biology. Like any vertebrate, fish is a bilaterally symmetrical animal, with its right and left sides mirror images. The skeleton is made up of many bones and provides much of the framework as it supports the remainder of the body and gives it rigidity. The scull, or cranium, is the part of the axial endoskeleton. It is a complex structure made of several components that enclose and protect the brain which is divided into several regions, and such sense organs as eyes and ears. The part of the scull called branchiocranium or visceral cranium is formed as a series of arches which support gills. The upper and lower jaws bear teeth, though skulls differ among the basic groups of fishes as to the presence of teeth and jaws.

The vertebral column runs along the upper part of the body cylinder. It is made of a series of bony or cartilaginous discs and is usually divided into precaudal and caudal vertebrae with various bony elements projecting from them. Dorsally, there is an elongated neural spine within which a neural arch is located, the spinal cord passing inside. Attached to the vertebrae are pleural ribs, usually from the third vertebra to the last precaudal one. They are distinct from intermuscular bones and serve to protect the viscera.

A characteristic of fishes are the fins. Most fishes have two sets of paired fins – the pectorals, just behind the gills on the side of the head, and the pelvics, usually situated farther back. The median or unpaired fins consist of the dorsal, anal and adipose fins. The dorsal fin located along the mid-line on the top of the body may be subdivided into a spiny and a soft part, depending on the material of fin rays. At the very back is the caudal, or tail fin which in different fish species can vary in both external shape and internal anatomy. Scales are the characteristic external covering of fishes. There are four basic types of scales: placoid, cosmoid, ganoid, cycloid.

The viscera includes muscles, cardiovascular system, alimentary canal, gas bladder, kidneys, liver, pancreas, intestine, gall bladder, gonads, and nervous system. Fish muscle is structurally similar to that of other vertebrata and are divided into three types: skeletal, smooth, or nonskeletal, and cardiac, or heart muscle. The heart consists of two chambers: auricle (or atrium) and ventrical. It is located posterior and ventral to the gills. The cardiovascular system also includes arteries, veins and capillaries. The basic flow of blood is straightforward: from the heart that works like a pump to the gills, to the organ systems, and back to the heart. The gas bladder (or swimming bladder) is a thin-walled sac filled with gas. It is located between the alimentary canal and paired kidneys. The length of intestine varies according to fish feeding habits. It is much shorter in carnivorous species in comparison to herbivorous ones.

Exercise 2. Comprehension. Answer the questions.

1. What makes fish similar to other vertebrates?
2. Which part of the fish skeleton encloses the brain?

3. What is the composition of the vertebral column?
4. Where does the spinal cord pass?
5. Which bones are attached to the vertebrae?
6. What kind of fins do fish possess?
7. What is the external covering of fishes?
8. Which organs are included in the viscera?
9. What are muscle types in fish?
10. How is the cardiovascular system in fish characterized?
11. What is a gas bladder in its form and content?
12. Why does the intestine length vary in different fish species?

Exercise 3. Match words in **A** and **B**.

A. Плавник, хрящевой, печень, сердце, нервный тяж, тазовый, ребро, позвоночник, пищеварительный тракт, мышца, предсердие, позвонок, вена, желудочек, кость, чешуя, почки, мозг, артерия, челюсть, спинной, зубы, пластинкообразный, желчный пузырь, грудной, кишечник, нейральная дуга, хвост, поджелудочная железа, висцеральный череп, внутренности, жабры, остистый отросток верхней дуги позвонка.

B. Jaw, alimentary canal, liver, visceral cranium, dorsal, heart, brain, rib, fin, viscera, placoid, auricle, pancreas, gall bladder, ventricle, teeth, gills, kidneys, neural arch, neural spine, spinal cord, intestine, cartilaginous, bone, pelvic, pectoral, tail, vertebral column, artery, vein, muscle, vertebra, scale.

Exercise 4. Find definitions to the following words:

branchiocranium, cardiovascular system, gills, viscera, alimentary canal, anatomy, fins, nervous system, artery, kidneys.

1. Wing-like structures, small or large, which give fish stability in water and aid them in moving or steering.
2. a) The scientific study of the physical structure of an animal or plant; b) The body of an animal (or human), or its structure.
3. Paired longitudinal structures located ventral to the vertebral column and involved in excretion and osmoregulation.
4. A part of a scull consisting of a series of endoskeletal arches that form gill arch supports.
5. A large blood vessel that brings blood to and from the gills.
6. The tract which consists of the mouth, pharynx, esophagus, stomach, intestine and rectum.
7. A system divided into cerebrospinal system (composed of the central nervous system and the peripheral one) and autonomic systems.

8. The organs and organ systems called “guts” in everyday language.

9. Organs located on either side of the pharynx and made up of threadlike structures called “filaments”.

10. A system that serves all bodily functions in fish: respiration, digestion, excretion, osmoregulation, etc.

Exercise 5. Fill in the blanks with appropriate words and word combinations given in italics:

unpaired, artery, muscles, tail, bones, placoid, jaw, circulatory system, scull, vertebra.

1. Identification of … is important in paleontology, in identifying food of predatory fishes, and in zooarcheology.

2. The … has two major components: the neurocranium and the branchiocranium.

3. The mandibular arch forms the upper … and is composed entirely of dermal bones in bony fishes.

4. Typically, there is one … per body segment of fish.

5. The main … of the body, the dorsal aorta, passes ventral to the precaudal vertebrae toward the end of the abdominal cavity.

6. Most bony fishes have equal-lobed … in which the caudal fin rays are arranged symmetrically.

7. In jawless fishes the median or … fins are supported by cartilaginous rods.

8. The outer layer of the … scale is hard, enamel-like vitrodentine, which is noncellular and has a very low organic content.

9. Seven main … are responsible for opening and closing the jaws during feeding and breathing.

10. Heart valves prevent backflow of blood and maintain pressure in the … … .

Exercise 6. Complete the sentences and translate them.

1. The basic pattern of the cardiovascular system …
2. Heart size as a proportion of body weight is lower in fishes …
3. The sexes in fishes are usually separate,…
4. The pancreas is both an endocrine organ …
5. The muscles involved in electrogeneration in some fish species…
6. The important factor is not only the actual length of the intestine…
7. The original function of the gas bladder was probably as a lung, …

a. and an exocrine organ that produces digestive enzymes.

b. and the gonads are usually paired.

c. but also the internal surface area of the intestinal mucosa.
d. are modified skeletal muscles.
e. is a single-pump, single-circuit system.
f. but in most fishes today it helps to control buoyancy.
g. than in other vertebrates.

Exercise 7. Change Russian words for their English equivalents. Read and translate the text.

The early history of fishes

As fishes were the first (позвоночные), it is important to understand their evolutionary history. Of extinct species the first were termed *Ostacoderms* ("shell-skinned"), as they had a bony shield that covered the (голова) and thorax. The next species were termed *Pteraspidomorphi*; the impressions on the inside of the head plates indicated that they had two separate olfactory bulbs in the (мозг). They also had symmetrical (хвост), full body armor, and multiple branchial openings.

Anaspida forms, such as *Pharingolepis*, originated in nearshore (морской) habitats and gradually entered (пресный) water. They were seldom larger than 15 cm, and their (тело) was covered largerly with overlapping, tuberculate scales. They also developed flexible, lateral, finlike projections that had (мышцы) and an internal (скелет), which provided them with considerable maneurability.

Thelodonts ('nipple (зубы)") were abundant and widespread. Most were depressed, with a horizontal (рот), asymmetrical tails and a detectable (боковая линия) running the length of the body. Many thelodonts had (спинной и анальный) "fins". While swimming they skimmed and filtered small (организмы) from bottom sediments. It is also suggested that some genera may have been water column swimmers.

Osteostracomorphi is a superclass containing one class and three orders of (бесчелюстной) fishes. The best known is a freshwater group *Cephalospidiforms* which evolved in jawed species. They had (парные) lateral appendages. The internal (анатомия) of the head was identified as consisting of the braincase containing cranial (нервы), olfactory opening, (кровь) vessels, two vertical semicircular canals and other details. Recent analyses indicate that the osteostracomorphs are distant ancestors to modern lampreys.

Exercise 8. Read the text and answer the questions in each passage.

LIVING REPRESENTATIVES OF PRIMITIVE FISHES

1. How can the relationship of modern and extinct fish species be proved?

It is a well-known fact that a small number of anatomically primitive species can be found on all the continents of the globe, often in tropical, subtropical, or swampy habitats. These fishes represent the last remaining representatives of groups that dominated aquatic environments during the Paleozoic and Mesozoic periods. The ancestry of some species can be easily traced to several extinct groups. The close relationship of others can only be surmised from anatomical similarities. These "living fossils" prove the fact that every species is a mixture of ancestral and derived characteristics.

2. Why are lancelets considered to be ancestors to fishes?

Lancelets are argued by many not to be fish because they lack many diagnostic characters. However, their evolutionary and anatomical affinities are much closer to the vertebrata, which justifies their being studied by ichthyologists. Lancelets differ from typical fishes by lacking most parts of a head: a cranium, a brain, complex eyes, external nostrils, or ears. They also lack vertebrae, scales, genital ducts, a heart, red blood cells, hemoglobin, gills, and have only one cell layer in the epidermis. The conclusion on similarities between lancelets and fishes is supported by the fact that lancelets have the perforated pharynx, segmented axial muscles, a notochord, a dorsal nerve cord, and a postanal tail.

3. To which extinct group of fishes are hagfish and lamprey related?

The extinct groups of fishes are very different from one another, as the extant jawless fishes differ from presumed ancestral groups and from each other. Hence, the ancestor-descendant relationship of such jawless fishes as hagfishes and lampreys is questioned. These species are traditionally treated as related orders in the subclass *Cyclostomata* ("round moths"), which is supported by recent molecular studies. Besides, they show similarities in the body morphology, which is thought to reflect convergent evolution. Besides anatomical features, they also share a host of physiological and biochemical characteristics. A major similarity between these species involves their immune responses, as well. Their immune system has immunoglobulin-type antigen receptors that produce pathogen-specific antibodies in response to microbes.

4. What is the main reason to deal with lampreys and hagfishes independently?

In spite of some similarities between hagfish and lamprey, it is recommended to deal with them individually and independently, and appreciate them as unique yet primitive organisms as they are. Hagfishes are more primitive and belong to separate,

non-vertebrate group of Mixinomorphi class. Lampreys are placed in the infraphylum Vertebrata, and are characterized by dermal skeletal elements and neural crest tissue. Although lampreys and hagfishes are scaleless, the former lack the mucus-producing capability as contrasted to the latter. Lampreys have one or two dorsal fins, while hagfishes have a single continuous caudal fin. The mouth of lampreys is terminal, that of the hagfishes is subterminal. These and other differences point out the disparate nature of the two species.

Exercise 9. Translate into English.

1. Некоторые виды рыб обладают спинным плавником, разделенным на две части, первая из которых образована твердыми колючими лучами.

2. Тело рыб покрыто чешуей, которая растет пропорционально росту рыбы.

3. Пищеварительный тракт рыб включает рот, челюсти, покрытые у большинства видов зубами, глотку, пищевод, желудок, кишечник, печень, поджелудочную железу, анальное отверстие.

4. У хищных рыб кишечник обычно короткий, а у растительноядных видов он длинный.

5. Как и у других позвоночных, нервная система рыб включает мозг, состоящий из нескольких разделов, нервы и органы чувств.

6. Жабры представляют собой жаберные дуги, покрытые тонкими жаберными лепестками.

Exercise 10. Look through the text in Exercise 8 once more and define its key idea. Write an abstract of 5-7 sentences to the text.

AQUACULTURE

The term "*aquaculture*" is distinguished from fishing by the idea of active human effort in maintaining or increasing the number of organisms involved, as opposed to simply taking them from the wild. According to the FAO, aquaculture "is understood to mean the farming of aquatic organisms including fish, molluscs, crustaceans and aquatic plants. Subsets of aquaculture include Mariculture (aquaculture in the ocean); Algaculture (the production of kelp/seaweed and other algae); Fish farming (the raising of catfish, tilapia and milkfish in freshwater and brackish ponds or salmon in marine ponds); and the growing of cultured pearls. Extensive aquaculture is based on local photosynthetical production while intensive aquaculture is based on fish fed with an external food supply.

Aquaculture has been used since ancient times and can be found in many

cultures. Pond growing of carp in China and tilapia in Egypt, was being done in 2000 BC. The Romans grew fish in “viviers”. In Europe, fish farming in ponds developed in the middle ages with the spread of the monasteries. In the 15th century, fish were captured as they swam up into brackish waters and were maintained in pools. Currently in Europe, aquaculture accounts for about 20% of fish production and directly employs some 80 000 people.

The farming of fish is the most common form of aquaculture. It involves raising fish commercially in tanks, ponds, or ocean enclosures, usually for food. Fish farming is mainly done in fresh water (87 %), and is above all a type of subsistence aquaculture, providing animal protein for local populations. Marine fish farming represents 9% of world fish production. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated.

Aquaculture can be more environmentally damaging than exploiting wild fisheries on a local area basis, but has considerably less impact on the global environment on a per kg of production basis. Local concerns include waste handling, side-effects of antibiotics, competition between farmed and wild animals, and using other fish to feed more marketable carnivorous fish. However, research and commercial feed improvements during the 1990s and 2000s have lessened many of these concerns.

Aquaculture may contribute to propagation of invasive species. As the cases of Nile perch and Janitor fish show, this issue may be damaging to native fauna. Fish waste is organic and composed of nutrients necessary in all components of aquatic food webs. In-ocean aquaculture often produces much higher than normal fish waste concentrations. The waste collects on the ocean bottom, damaging or eliminating bottom-dwelling life. Waste can also decrease dissolved oxygen levels in the water column, putting further pressure on wild animals.

Some profitable aquaculture cooperatives promote sustainable practices. New methods lessen the risk of biological and chemical pollution through minimizing fish stress. Vaccines are being used more and more to reduce antibiotic use for disease control. Onshore recirculating aquaculture systems, facilities using polyculture techniques, and properly sited facilities (for example, offshore areas with strong currents) are examples of ways to manage negative environmental effects.

Учебно-методическое и информационное обеспечение дисциплины (модуля) представлено в рабочей программе дисциплины