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КАФЕДРА ІНОЗЕМНИХ МОВ ПРОФЕСІЙНОГО СПРЯМУВАННЯ

AQUACULTURE

ЕЛЕКТРОННІ МЕТОДИЧНІ ВКАЗІВКИ
до практичних занять та самостійної роботи
з навчальної дисципліни «Англійська мова»
для здобувачів першого року навчання
другого (магістерського) рівня вищої освіти
спеціальності H5 Водні біоресурси та аквакультура

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Укладач:

О. Ю. Куделіна, старший викладач кафедри іноземних мов професійного спрямування.

Рецензенти:

О. М. Набока, кандидат філологічних наук, доцент, завідувачка кафедри іноземних мов професійного спрямування;

Г. В. Ткаченко, кандидат філологічних наук, доцент, завідувачка кафедри лексикології і стилістики англійської мови.

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А69 **Aquaculture** [Електронний ресурс] : електрон. метод. вказівки до практ. занять та самост. роботи з навч. дисципліни «Англійська мова» для здобувачів першого року навчання другого (магіст.) рівня вищ. освіти спец. H5 Водні біоресурси та аквакультура /уклад. О. Ю. Куделіна. Одеса : ОНУ імені І. І. Мечникова, 2026. 127 с. 1,4 МБ.

Методичні вказівки «Aquaculture» рекомендовані для формування та вдосконалення умінь та навичок роботи з фаховими автентичними матеріалами англійською мовою. Укладені відповідно до робочої програми навчальної дисципліни «Англійська мова за професійним спрямуванням», яка є обов’язковою дисципліною для здобувачів 1 курсу другого (магістерського) рівня вищої освіти спеціальності H5 «Водні біоресурси та аквакультура»

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ВСТУП

Методичні вказівки «Aquaculture» розроблені для практичних та організації самостійних занять з дисципліни «Англійська мова за професійним спрямуванням» для здобувачів другого (магістерського) рівня вищої освіти за спеціальністю H5 «Водні біоресурси та аквакультура».

Метою курсу є підготовка висококваліфікованих фахівців, які поєднують професійні знання у сфері аквакультури з високим рівнем володіння англійською мовою.

Володіння іноземною мовою є не лише ознакою якісної освіти, але й невід'ємною характеристикою сучасного фахівця. У методичних вказівках представлено тексти для читання та обговорення за тематикою, зумовленою професійними потребами, що сприяють отриманню новітньої фахової інформації з іноземних джерел, формуванню навичок усного монологічного та діалогічного мовлення в межах загальноекологічної та фахової професійної тематики, а також розвитку комунікативної компетентності у сферах професійного та ситуативного спілкування в усній і письмовій формах.

Методичні вказівки складаються з чотирьох розділів і включають професійно орієнтовані автентичні навчальні тексти за темами «Водні біоресурси та аквакультура», а також завдання, спрямовані на поглиблення їх розуміння. Переклад текстів виконується самостійно, а пов'язані з ними завдання під час аудиторних занять. Запропоновані завдання спрямовані на вдосконалення професійних знань, розвиток умінь їх використання в англомовній професійній діяльності, а також на формування навичок усної та письмової комунікації.

UNIT I
AQUACULTURE

TEXT 1

Task 1. Read the text and be ready to retell it.

THE HISTORY OF AQUACULTURE

Aquaculture is traced from its origins in China via Roman vivariae piscine (fish ponds) through technical and scientific advances to the twentieth century's expansive growth and globalization. Today, aquaculture complements wild-catch fishing as a sustainable source of high-quality protein.

Aquaculture consists in farming aquatic organisms. Around 500 BCE, the Romans farmed oysters and fish in Mediterranean lagoons, whereas freshwater aquaculture developed empirically some 1000 years earlier in China. Farming carp in ponds led to the complete domestication of this species in the Middle Ages, which is also when mussel farming began, following a technique that remained largely unchanged until the 20th century.

Farming in ponds through the ages

The earliest evidence of fish farming dates back to before 1000 BC in China. The Zhou dynasty (1112-221 BCE), then the politician Fan Li, around 500 BC, were the first to describe carp, a symbol of good luck and fortune, as being farmed for food. During the Tang dynasty, around 618, the Emperor Li, whose name means ‘carp’, forbade farming the fish that bore his name. Farmers then turned their attention to similar fish in the *Cyprinidae* family and developed the first form of polyculture. Liquid manure from livestock farming was also used to stimulate algae growth in ponds and make it more nutritious. The pond beds were then drained so that they in turn were also used as fertiliser. The first integrated agriculture-aquaculture systems emerged in China, where they are still implemented today.

In Europe, aquaculture first began in Ancient Rome. The Romans, who loved sea fish and oysters, created oyster farms and adopted the Assyrian vivarium, a kind of ‘swimming pool’ where fish and crustaceans caught in lagoons were kept alive until it was time to eat them. These vivaria were built inside wealthier homes, where guests could choose the fish they wished to eat.

In the Middle Ages, throughout feudal Europe, the monastic orders and the aristocracy were the main users of freshwater fish vivaria, since they had a monopoly over the land, forests and water courses. Mussel farming was invented in the 13th century and the technique remained largely unchanged until the 1960s. As with hunting, poaching was severely punished and the less well-off would have to wait a few centuries before fresh fish was served on their plates.

Freshwater fish farming was further developed during the Renaissance. Several treatises were published, providing details on pond construction and management techniques, the choice of species to farm, their diseases and their diet. Carp dominated the artificial ponds of Eastern Europe. Emperor Charles IV ordered many such ponds to be built in Bohemia, what is now the westernmost region of the Czech Republic.

Artificial breeding was discovered in Germany during the Enlightenment, but it was not until the 19th century, an era of rapid industrialisation, that anyone paid much attention to it. In a hundred years industry changed the European landscape. Pollution caused fish populations to diminish and dams and irrigation canals obstructed the migratory paths of some species, such as salmon. To combat this dramatic decline, artificial breeding research focused on trout farming, and researchers managed to master all stages of the process, from fertilisation to egg storage and transportation, pond farming and releasing fish into the wild. Hatcheries appeared all over the West and, in the 1860s, trout and other salmonids colonised rivers around the world, in the United States, India, New Zealand and even Japan, one of the first producers of edible seaweed.

During the first five decades of the 20th century, colonists introduced and then farmed other species of fish in the Anglo-Belgian colonies in Africa, whether for leisure fishing, to prevent the spread of malaria (using insect-eating species), or as a food source (tilapia for example). In the kibbutzim of Israel, farmers adapted traditional methods imported from Eastern Europe to the arid environment and developed new techniques, enabling them to achieve self-sufficiency in fish products.

In the late 1950s, the invention of artificial granulated food revolutionised fish farming, which until then had relied on products from agriculture and livestock farming (raw meat, for example), to feed the fish.

During the 1970s, marine species aquaculture enjoyed a revival, thanks to new, lighter, more hard-wearing and less expensive building materials (fibre glass, plastic tubes) and the use of floating cages rather than expensive glass and cast iron saltwater ponds. However, these new facilities turned out to be commercially non-viable and the optimisation and stabilisation of marine fish production was a major concern in the following decade.

The start of the 21st century saw aquaculture have taken great importance worldwide. According to a report on fishing and aquaculture by the Food and Agriculture Organization of the United Nations (FAO) in 2016, "In terms of global production volume, that of farmed fish and aquatic plants combined surpassed that of capture fisheries in 2013".

China, because of its history of aquaculture, has produced more than the rest of the world every year since 1991 in 2016. Other top producers in 2016 were India, Indonesia, Viet Nam, Bangladesh, Egypt and Norway.

COMPREHENSIVE CHECK

Task 2. Provide Ukrainian equivalents for the following words and expressions, learn them, and use into your retelling.

Aquaculture, wild-catch fishing, sustainable source of protein, farming aquatic organisms, freshwater aquaculture, marine aquaculture, roman vivariae (fish ponds), carp domestication, poly culture, integrated agriculture-aquaculture systems, oyster farming, tang dynasty aquaculture,assyrian vivarium, medieval monastic fish farming, artificial breeding, industrialization and fish farming, hatcheries, trout and salmonid farming, tilapia farming in Africa, kibbutzim aquaculture, artificial granulated food, floating cages, fiberglass and plastic tube materials. saltwater ponds, fish fertilization techniques, pond drainage for fertilization, global production volume of farmed fish, commercial viability of aquaculture, optimization and stabilization of marine fish production.

Task 3. Answer the following questions using active vocabulary from the text.

1. When did aquaculture first appear?
2. What and where were the first farms?
3. What was used to stimulate algae growth in ponds and make it more nutritious?
4. What was the second using for pond beds?
5. What was published in the treatises during the Renaissance?
6. What fish was dominated in the artificial ponds of Eastern Europe?
7. What caused fish populations to diminish?
8. What is aquaculture, and how does it complement wild-catch fishing?
9. How did aquaculture evolve from its origins to the modern-day industry?
10. Why is aquaculture considered a sustainable source of protein?
11. When and where did aquaculture originate?
12. How did the Romans practice aquaculture?
13. What role did China play in the early development of aquaculture?
14. How did monastic orders and aristocracy influence fish farming in feudal Europe?
15. How did artificial breeding impact fish farming in the 19th century?
16. What role did aquaculture play in colonial Africa and the kibbutzim of Israel?
17. How did the invention of artificial granulated food change aquaculture in the 1950s?
18. What technological advancements in the 1970s contributed to the revival of marine aquaculture?
19. When did farmed fish and aquatic plant production surpass wild-catch fisheries in volume?
20. What are polyculture and integrated agriculture-aquaculture systems, and how did they develop in China?
21. How did the Middle Ages contribute to the domestication of fish species like carp?
22. What were some of the major challenges faced by fish farmers in the 19th and 20th centuries?

23. How did pond farming evolve from the Renaissance to modern times?
24. Why were floating cages introduced in marine aquaculture, and what were their drawbacks?

Task 4. Match each term on the left with its definition on the right.

Terms	Definitions
1. Aquaculture	A. The practice of cultivating fish, shellfish, and aquatic plants in controlled environments.
2. Wild-catch fishing	B. The process of harvesting fish and other seafood directly from natural bodies of water, such as oceans, rivers, and lakes.
3. Sustainable source of protein	C. A method of producing food that ensures long-term availability while minimizing environmental impact.
4. Farming aquatic organisms	D. The broader concept of breeding and raising fish, mollusks, crustaceans, and aquatic plants for human consumption.
5. Freshwater aquaculture	E. The farming of fish and other aquatic species in non-salty water, such as lakes, ponds, and rivers.
6. Marine aquaculture	F. The cultivation of seafood in saltwater environments, including oceans and coastal areas.
7. Polyculture	G. A structure used for keeping and growing young fish before release
8. Vivarium	H. Farming of multiple species in the same environment
9. Hatchery	I. Organisms that live in water
10. Lagoon	J. The process by which humans adapt wild species for use
11. Domestication	K. Related to monks or monasteries
12. Monastic	L. A pool or tank where fish or aquatic animals are kept alive
13. Fertilisation	M. The process of union of male and female gametes
14. Integrated system	N. A shallow body of water separated from a larger sea
15. Aquatic organisms	O. A farming system that combines agriculture and aquaculture

Task 5. Complete the sentences with appropriate words from the text.

1. The earliest evidence of fish _____ dates back to before 1000 BC in China.
2. During the Tang dynasty, polyculture was developed using members of the _____ family.
3. In Ancient Rome, _____ were used to keep fish and crustaceans alive.
4. Monastic orders in the Middle Ages used freshwater fish _____.
5. Mussel farming was invented in the _____ century.
6. Emperor Charles IV ordered ponds to be built in _____.
7. Pollution and dams caused a decline in _____ species.
8. Artificial _____ allowed full control over trout reproduction.
9. In Israel, kibbutzim adapted traditional aquaculture to an _____ environment.
10. In the 1950s, _____ fish food revolutionized feeding practices.

Task 6. Choose the correct option to complete the sentence based on the text.

1. Carp farming in China led to …
   a) extinction of native species
   b) religious conflicts
   c) full domestication
   d) ocean pollution
2. The vivariae of Ancient Rome were used …
   a) as aqueducts
   b) for recreation
   c) to store food grains
   d) to keep fish alive
3. Polyculture was a response to:
   a) food shortages
   b) a farming ban
   c) rising sea levels
   d) overfishing
4. Mussel farming remained unchanged until …
   a) the 15th century
   b) the 20th century
   c) 1850
   d) Ancient Rome
5. During the Industrial Revolution, fish stocks declined due to …
   a) improved fishing methods
   b) genetic manipulation

c) water pollution and dams
d) fish overpopulation

6. Artificial granulated feed was introduced in …
a) 1920s
b) 1950s
c) 1980s
d) 2000s

7. Aquaculture became globally important in …
a) the 17th century
b) the early 1900s
c) the 21st century
d) the 1960s

8. Hatcheries allowed for:
a) breeding fish in the wild
b) keeping fish as pets
c) controlling all growth stages
d) processing fish for trade

9. Fibre glass and plastic tubes were used to …
a) build vivaria
b) support floating cages
c) drain ponds
d) process feed

10. According to FAO, farmed fish production surpassed capture fisheries in …
a) 2010
b) 2013
c) 2020
d) 1999

Task 7. Match the historical period or date with the event described.

Date/Period	Event
Before 1000 BC	A. Marine aquaculture revived using new materials
500 BC	B. Fan Li writes about carp farming
618 BC	C. Invention of mussel farming
13th century	D. Trout hatcheries and fish breeding methods spread
Renaissance	E. Expansion of pond farming and scholarly treatises
Middle Ages	F. Emperor bans farming of carp
19th century	G. Roman vivaria used for storing fish
1950s	H. Introduction of artificial fish food

1970s	I. Farmed production surpasses wild catch
2013	J. Monks and nobility manage freshwater ponds

Task 8. Find words in the text that match the definitions below.

1. A group of fish related to carp: _____
2. A shallow coastal body of water separated from the sea: _____
3. A place where young fish are bred: _____
4. A type of floating structure used in modern marine farming: _____
5. Nutrient-rich waste from livestock: _____
6. A farming method combining plant and fish farming: _____
7. A lightweight building material used in cages: _____
8. A historical period marked by scientific progress: _____
9. A symbolic fish in Chinese culture: _____
10. The process of adapting animals for human use: _____

Task 9. Match the word from the left column with the most appropriate word from the right column.

Left column	Right column
1. Artificial	A. ponds
2. Fish	B. aquaculture
3. Oyster	C. vivaria
4. Floating	D. feed
5. Monastic	E. species
6. Freshwater	F. cages
7. Marine	G. farming
8. Salmonid	H. fish
9. Carp	I. systems
10. Integrated	J. orders

Task 10. Make up as more sentences as you can using the words and expressions from Task 2.

Task 11. Write a brief summary of the text. Read your summaries of the text to your groupmates.

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.

Task 12. Make up a plan of this text. Retell the text according to it.

Task 13. Translate the following text into Ukrainian.

History of aquaculture

The history of aquaculture started in China around 3000 BC. Artificial lakes contained specific fish such as carp when the water level was lowered after river floods. Their eggs were then fed with nymphs and excrement of silkworms used for silk production. The Romans were quite skilled at breeding fish in ponds. In Europe, fish was rare and therefore expensive and became common in monasteries in the Middle Ages. 19th century improvements in transportation made fish readily available and inexpensive, even far from the seas, leading to a decline in aquaculture. The current boom began in the 1960s after overfishing caused prices to rise again. Today, commercial aquaculture exists on a considerable scale that was previously unheard of, generating controversy because of its effects on public waters beyond enclosure boundaries.

TEXT B

Task 1. Read the text and be ready to retell it.

AQUACULTURE AND FISH FARMING

What is aquaculture and fish farming?

Aquaculture and fish farming are both raising aquatic organisms for breeding and rearing. It is mostly practiced for commercial purposes for both freshwater and saltwater organisms. Indeed, it is performed under controlled conditions to create an ideal environment for survival and growth of aquatic animals.

Fish farming is the main form of aquaculture available. This is the method to raise fish artificially for reproduction and transportation. Usually, large tanks are used to raise fish on a commercial basis.

Difference between aquaculture and fish farming

AQUACULTURE	PISCICULTURE
The production of all types of aquatic organisms in water areas.	Production of freshwater or saltwater fish only
Small amount of special food from outside.	We provide fish food from outside
Major production	Mainly food production

What is aquaculture?

Aquaculture is the cultivation of aquatic organisms such as fish, shellfish and even plants. This term refers to the cultivation of marine and freshwater species and can range from land-based to deep-sea production.

Present for several millennia, aquaculture has been improving with time. Today, the ponds are located in ponds, enclosures. Fish swim freely in large net structures in the protected coastal areas. This means they have continuous access to clean water and exercise, so the fish are healthy, lean and firm.

This Europian sea bass operation in Piran, Slovenia, benefits from developments that have been made in aquaculture technologies that stretch back over a century.

What is aquaculture and why is it important?

Because 70% of the planet’s surface is covered by water, humans have understood its importance as a resource. This is why aquaculture is the most exploited in terms of water use as a resource. This is especially true in food production as opposed to land use.

It fulfills various purposes, including:

- food production
- Restoring populations that are threatened and endangered,
- population enhancement of wild stocks
- aquarium construction
- fish farming
- Home rehabilitation.

Examples of aquaculture:

Mariculture is the branch of aquaculture that cultivates marine organisms. It is practiced either :

- at sea
- in a closed part of the ocean
- in basins or ponds filled with sea water.

Organisms grown in salt water are:

- fish like flounder and whiting
- Seafood (such as shrimp and oysters)
- marine plants (such as kelp and seaweed)

Cosmetics and jewelry such as cultured pearls also use the products of mariculture.

Algaculture is the type of aquaculture that cultivates seaweed. Most of the algae collected are microalgae (phytoplankton, microphytes or planktonic algae) or macroalgae, commonly known as seaweed.

Although macro-algae are used for various commercial purposes, its size and cultivation requirements make it difficult to grow. Microalgae are easier to grow on a large scale.

Plants in aquaculture

Aquaculture refers to the cultivation of aquatic organisms in a safe and controlled way. It uses several types of wastewater as a source of nutrients and/or warm temperatures for the growth of plants and fish. In the production of aquaculture plants, there are two main methods of cultivation:

- **Hydroponics**: the place where plants are cultivated with roots directly exposed to water

- **Floating Plant Ponds**: A floating plant pond is a modified maturation pond with floating plants (macrophytes). Plants such as hyacinths or duckweed float in them while the roots hang in the water to absorb nutrients and filter the flowing water.

Example of aquaculture: shellfish farming

Environment and aquaculture interactions

By increasing aquaculture, fish farming in particular, there is less need to fish the wild stock. As a result, it puts less stress on the ecosystem and also reduces human interference.

In addition, the actions of motorboats and other human influences such as the removal of viable spawning adult fish are stressing aquatic ecosystems. Their interruption allows the ecosystem to flourish and return to its natural balance.

1. Types of aquaculture

Several aquaculture practices are applied worldwide. There are several types of aquaculture:

- extensive or intensive
- in a natural environment or in a pond
- in fresh or salt water
- in circulation or recirculation systems

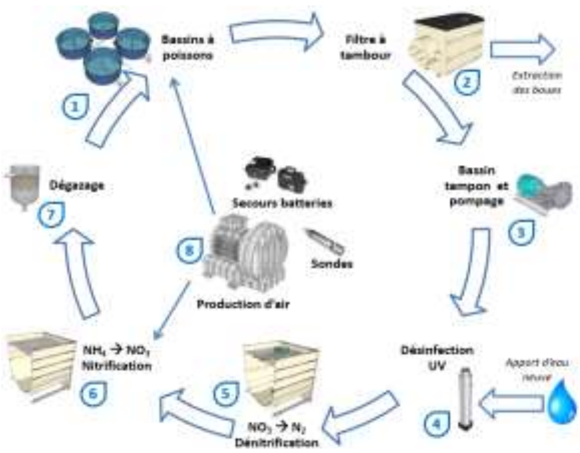
While these practices allow for a wide variety of breeding organisms, they require specific techniques and equipment.

At the outlet of the fish tank, the water first flows to a mechanical filter allowing the elimination of the contained organic waste. The finest particles and dissolved compounds such as phosphate then pass through the mechanical filter.

This is why the water goes to a biological filter, to decompose organic matter and ammonia. All this, before being aerated and cleaned of carbon dioxide and returned to the aquariums.

This is the biological process carried out by bacteria in the bio filter.

1. FISH FARMING PONDS: In the water, fish feed and produce excrement, rich in ammonia.
2. MECHANICAL FILTRATION: The particulate and dissolved waste contained in the water of the rearing tanks is eliminated through a drum filter.
3. WATER FLOW POND: The water flows to a first intermediate storage pond, the water flow pond.
4. UV DISINFECTION: An ultraviolet treatment destroys the bacteria and viruses contained in the water coming from the breeding ponds.
5. BIOLOGICAL FILTRATION: A biological filter supports specific bacteria that convert ammonia into non-toxic nitrate.



Recirculating aquaculture (RAS)

A recirculating aquaculture system is an almost completely closed circuit.

- The waste products produced; solid waste, ammonium and CO2, are either removed or converted to non-toxic products by the system components.
- The purified water is then saturated with oxygen and returned to the aquariums.
- By recirculating crop water, water and energy requirements are kept to a minimum. However, it is not possible to design a completely closed recirculation system.

- Non-degradable waste should be removed and evaporated water replaced.

Nevertheless, our recirculating systems are capable of reusing 90% or more of the culture water. To ensure proper water purification, we provide recirculating systems with a number of components with specific functions. The advantages of farming in SAR are:

- Fully controlled environment for fish
- Low water consumption
- Efficient energy use
- Efficient land use
- Optimum feeding strategy
- Easy grading and harvesting of fish
- Total control of disease
- Recirculating aquaculture systems constraints

Growing aquaculture recirculation systems are the best option for nearby sites or in cities, with good availability of electricity. Furthermore, the use of RAS technology is the only possibility for rearing tropical fish species in moderate to cold indoor climates.

1H_2O_3 aquaculture supplies

The technique of 1H_20_3 allows to realize several modelling of system to realize aquaculture techniques whatever its type. Actually, the assembly for aquaculture uses MBBR technology. This requires 8 boxes connected to each other as follows:

1. STORAGE BOX (TAMPON PONDS): Intermediate water storage box
2. THE MOTOR BOX: Obligatory box for the functioning of the aquaponics system. It has an aerator and a UV disinfection and a feed pump for the installation
3. MBBR BOX : Biological denitrification filter (biofilter)
4. BOX MBBR : Biological nitrification filter (biofilter)
5. STORAGE BOX (BUFFER POND)
6. FISH TANK with a nitrogen gas degassing system
7. DRUM FILTER BOX: Filter technology box for water purification
8. COLLECTION/SETTLING BOX (SLUDGE STORAGE AND SEPARATION): It collects the treated water for feeding the ponds. It is also used for settling and storing sludge.

COMPREHENSIVE CHECK

Task 2. Provide the Ukrainian equivalents for the following words and expressions, learn them and use in your retelling.

Piscine, wild-catch fishing, a sustainable source, oysters, complete domestication, mussel farming, similar, liquid manure, livestock farming, to stimulate, fertilizer, crustaceans, poaching, artificial ponds, to diminish, storage , to release, species, granulated food, raw meat, floating cages, to obstructe, breeding and rearing, irrigation canals, shellfish, population enhancement, migratory paths, to be commercially non-viable, lagoons, polyculture, salmonids, facilities.

Task 3. Answer the following questions using active vocabulary from the text.

1. What is aquaculture?
2. What is the main goal of fish farming?
3. What are the main differences between aquaculture and pisciculture?
4. Why is aquaculture considered important for the environment?
5. What organisms can be cultivated in aquaculture besides fish?
6. What is mariculture and where is it practiced?
7. Give three examples of marine organisms raised in mariculture.
8. What is algaculture? What are its two main types?
9. Why is microalgae cultivation more common than macroalgae?
10. What are the two methods of plant cultivation in aquaculture?
11. How does aquaculture reduce pressure on wild fish populations?
12. What human activities negatively affect aquatic ecosystems?
13. Name four types of aquaculture based on water type or environment.
14. What is the purpose of mechanical filtration in aquaculture systems?
15. What does a biological filter do in the water treatment process?
16. What is the function of UV disinfection in aquaculture systems?
17. What does RAS stand for, and what does it do?
18. List three advantages of recirculating aquaculture systems.
19. What are the limitations of RAS systems?
20. What is MBBR technology and how is it used in aquaculture?

Task 4. Match each term on the left with its definition on the right.

Terms	Definitions
1. Aquaculture	A. A method to kill bacteria and viruses using ultraviolet light
2. Fish farming	B. A system in which water is purified and reused
3. Mariculture	C. Farming of all aquatic organisms under controlled conditions
4. RAS	D. Device used to clean water biologically by bacteria
5. Biofilter	E. Growing plants with roots exposed directly to water
6. UV disinfection	F. Algae farming
7. Hydroponic	G. Commercial fish farming
8. Mechanical	H. Removal of solids and particles from water using physical filtration means

Task 5. Translate the collocations.

1. Shellfish Floating plant pond
2. Marine environment
3. Controlled conditions
4. Fish breeding tank
5. Nutrient-rich water
6. Commercial aquaculture production
7. Removal of waste
8. Sustainable fish farming
9. Aquatic organisms
10. Recirculating aquaculture system
11. Mechanical filter
12. Biological filtration
13. Sustainable production
14. Marine plants
15. Fish tank
16. Biofilter
17. Wastewater

Task 6. Match the terms with the translations.

Terms	Definitions
1. Aquaculture	A. Морське розведення
2. Fish farming	B. Аквакультура

3. Biofilter	C. Молюски
4. Mariculture	D. Ультрафіолетова дезінфекція
5. Shellfish	E. Розведення риби
6. UV disinfection	F. Біофільтр
7. Recirculating system	G. Стічні води
8. Wastewater	H. Замкнута система циркуляції води

Task 7. Fill in the blanks. Use the words from the list.
(*aquaculture, fish farming, mariculture, biofilter, recirculation, UV disinfection, recirculating, aquatic, nutrients, aquaculture, saltwater, algae, filter, shellfish*).

1. ______ is the controlled cultivation of aquatic organisms.
2. The main type of aquaculture is _____.
3. In ______, marine organisms are raised in seawater environments.
4. The ______ helps remove ammonia by using bacteria.
5. ______ systems reuse up to 90% of the water.
6. ______ is used to eliminate bacteria and viruses from the water.
7. ______ organisms include fish, plants, and shellfish.
8. ______ is the farming of fish and other water species.
9. A ______ system reuses and purifies water for repeated use.
10. Seaweed and kelp are types of _____.
11. A biological _____ helps to remove ammonia from water.
12. Mariculture grows organisms in _____ environments.
13. Plants absorb _____ from the water in hydroponics systems.
14. Oysters and shrimp are examples of _____.

Task 8. Match the words from the left column with the matching words from the right column.

Left column	Right column
1. fish	pond
2. biological	farming
3. mechanical	system
4. floating	filter
5. aquaculture	filtration
6. recirculating	plants

Task 9. **Read the definition and write the notion.**

1. A place where fish are kept and grown commercially. _____
2. A process that uses ultraviolet light to kill bacteria. _____
3. A farming method for seaweed or algae. _____
4. A system that converts ammonia into non-toxic nitrate. _____
5. The branch of aquaculture involving the ocean. _____
6. Organic or inorganic matter removed from water. _____
7. Farming of aquatic animals and plants. _____
8. A device that removes solid waste from water. _____
9. A system where water is reused after being filtered. _____
10. Small organisms like plankton used in algaculture. _____

Task 10. Make up as more sentences as you can using the words and expressions from Task 3.

Task 11. Write a brief summary of the text. Read your summaries of the text to your groupmates.

Task 12. Make up a plan of this text. Retell the text according to it.

Task 13. Read the text and write a brief summary in English.

SEAWEED FARMING

Seaweed farming or kelp farming is the practice of cultivating and harvesting seaweed. In its simplest form farmers gather from natural beds, while at the other extreme farmers fully control the crop's life cycle. The seven most cultivated taxa are Eucheuma spp., Kappaphycus alvarezii, Gracilaria spp., Saccharina japonica, Undaria innatifida, Pyropia spp., and Sargassum fusiforme. Eucheuma and K. alvarezii are attractive for carrageenan (a gelling agent); Gracilaria is farmed for agar; the rest are eaten after limited processing. Seaweeds are different from mangroves and seagrasses, as they are photosynthetic algal organisms and are non-flowering.

The largest seaweed-producing countries as of 2022 are China and Indonesia; followed by South Korea and the Philippines. Other notable producers include North Korea, Japan, Malaysia, Zanzibar (Tanzania), and Chile. Seaweed farming has frequently been developed to improve economic conditions and to reduce fishing pressure.

The Food and Agriculture Organization (FAO) reported that world production in 2019 was over 35 million tonnes. North America produced some 23,000 tonnes of wet seaweed. Alaska, Maine, France, and Norway each more than doubled their seaweed production since 2018. As of 2019, seaweed represented 30% of marine aquaculture. In 2023, the global seaweed extract market was valued at $16.5 billion, with strong projected growth.

Seaweed farming is a carbon negative crop, with a high potential for climate change mitigation. The IPCC Special Report on the Ocean and Cryosphere in a Changing Climate recommends "further research attention" as a mitigation tactic. World Wildlife Fund, Oceans 2050, and The Nature Conservancy publicly support expanded seaweed cultivation.

The earliest seaweed farming guides in the Philippines recommended the cultivation of Laminaria seaweed and reef flats at approximately one meter's depth at low tide. They also recommended cutting off seagrasses and removing sea urchins before farm construction. Seedlings are tied to monofilament lines and strung between mangrove stakes in the substrate. This off-bottom method remains a primary method Long-line cultivation methods can be used in water approximately 7 meters (23 ft) in depth. Floating cultivation lines are anchored to the bottom and are widely used in North Sulawesi, Indonesia.

Species cultured by long-line include those of the genera Saccharina, Undaria, Eucheuma, Kappaphycus, and Gracilaria. Cultivation in Asia is relatively low-technology with a high labor requirement. Attempts to introduce technology to cultivate detached plant growth in tanks on land to reduce labor have yet to attain commercial viability.

A bacterial infection called ice-ice stunts seaweed crops. In the Philippines 15 percent reduction in one species appeared in 2011 to 2013, representing 268,000 tonnes of seaweed. The spread of ice-ice disease is strongly associated with increasing seawater temperatures.

Ecological impacts

Seaweed is an extractive crop that has little need for fertilisers or water, meaning that seaweed farms typically have a smaller environmental footprint than other agriculture or fed aquaculture. Many of the impacts of seaweed farms, both positive and negative, remain understudied and uncertain.

Nonetheless, many environmental problems can result from seaweed farming. For instance, seaweed farmers sometimes cut down mangroves to use as stakes. Removing mangroves negatively affects farming by reducing water quality and mangrove biodiversity. Farmers may remove eelgrass from their farming areas, damaging water quality. Seaweed farms are routinely placed on top of seagrass meadows, particularly across Southeast Asia and the Western Indian Ocean, and numerous negative impacts occur.

Seaweed farming can pose a biosecurity risk, as farming activities have the potential to introduce or facilitate invasive species. For this reason, regions such as the UK, Maine and British Columbia only allow native varieties.

Farms may also have positive environmental effects. They may support welcome ecosystem services such as nutrient cycling, carbon uptake, and habitat provision. Evidence suggests that seaweed farming can have positive impacts which include supplementing human diets, feeding livestock, creating biofuels, slowing climate change and providing crucial habitat for a marine life, but must scale sustainably in order to have these effects. One way for seaweed farming to scale at terrestrial farming levels is with the use of ROVs, which can install low-cost helical anchors that can extend seaweed farming into unprotected waters.

Seaweed can be used to capture, absorb, and incorporate excess nutrients into living tissue, aka nutrient bioextraction/bioharvesting, is the practice of farming and harvesting shellfish and seaweed to remove nitrogen and other nutrients from natural water bodies.

Similarly, seaweed farms may offer habitat that enhances biodiversity. Seaweed farms have been proposed to protect coral reefs by increasing diversity, providing habitat for local marine species. Farming may increase the production of herbivorous fish and shellfish. Pollinac reported an increase in Siginid population after the start of farming of Eucheuma seaweed in villages in North Sulawesi.

TEXT 3

FISH FARMING

Task 1. Read the text and be ready to retell it.

Fish farming is one of the branches of aquaculture. It involves the commercial rearing of fish in tanks or pens such as fish ponds, usually for food.

This is the principal method of aquaculture, while other methods can be assimilated to mariculture. A structure that releases wild juvenile fish for sport fishing or to supplement the natural numbers of a species is generally referred to as a *hatchery*. Fish farming professionals are grouped into unions or national representative bodies. Indeed, they carry out their activity within the framework of a respectful approach of the environment while focusing on a high quality production.

There are 33.8 million tons worth about US$60 billion according to the 2008 global fish farming revenues recorded by the FAO. This makes fish farming a sector with great economic potential.

Fish farming process

Method 1

The first method is through a system of cages placed in lakes, ponds and oceans containing the fish. This method is also commonly referred to as sea farming.

- Fish are kept in cages as part of the structure and are "artificially fed" and harvested.
- This cage method has made many technological advances over the years, especially with the reduction of disease and environmental concerns.
- However, the main concern with this method is that the fish escape and become detached among the wild fish population.

Method 2

The second method is to use ditch or irrigation pond systems to raise fish. The basic requirement for this method is to have a ditch or pond that holds water.

This system is unique because :

- On a small basis, the fish are fed artificially and the waste produced by the fish is then used to fertilize the farmers' lands.
- On a larger scale, especially in ponds, the pond is self-sufficient because it produces plants and algae to feed the fish.

Method 3

The third method of fish farming is composite fish farming. This is a type that allows local and imported fish species to coexist in the same pond. The number of species may depend, but it is possible to have more than six species of fish in a single pond. Fish species are always carefully selected to ensure coexistence and reduce competition for food.

Method 4

This method is considered to be the most common "pure" method of fish farming.

- This approach uses large plastic tanks placed in a greenhouse.
- There are hydroponic beds placed near the plastic tanks.
- The water in the clay tanks is pumped to the hydroponic beds.
- This is where fish waste feed is used to provide nutrients to plants grown in hydroponic beds. The majority of the types of plants grown in hydroponic beds are herbs such as parsley and basil.

The last type of fish farming method is the “continuous flow system”. This is when farmed fish species are raised from eggs and then dumped into streams.

Fish Farming Project

Pond fish farming, with an earthen basin, in which the fish feed themselves completely or partially from the biological production of the environment.

Intensive fish farming in artificial ponds or cages, in which the fish are fed exclusively with food provided by the fish farmer.

Fish used for fish farming

For the fish farming technique, different types of freshwater and saltwater fish can be produced. Freshwater fish species are: The Rainbow Trout is undoubtedly the most widespread. Rainbow trout is the most produced species with over 32,000 tons. – The Fario trout. Little tamed, it is essentially intended for the repopulation of rivers. – Brook Trout or Brook Salmon. – Arctic Char. – Sturgeon. – Carp.

A common scene in intensive fish farming (tilapia)

What are the advantages and disadvantages of aquaculture?

Like every farming, there are some advantages and disadvantages of aquaculture.

Benefits of aquaculture

Aquaculture sustainability

Aquaculture offers alternatives to marine fisheries. Increased demand for food products and globalization has led to an increase in fishing. However, this has led to fishermen becoming selfish and overfishing on desirable or high demand species. With aquaculture, they offer both an alternative and an opportunity for wild stocks to replenish their overtime.

Aquaculture Efficiency

Fish convert nutrients into body protein more efficiently than cattle or chickens. This means that fish companies are producing more feed for less feed. Such efficiency means that less food and energy are used to produce food. Moreover, the manufacturing process is also less expensive. It saves resources and even produces more food. This allows to secure the reserves and minimize the environmental constraints.

Economic impact

Dependence on aquaculture

Fish and other seafood are good sources of protein. They also have a higher nutritional value, such as the addition of natural oils in the diet, such as omega-3 fatty acids. Also, since it provides white meat, it is better for cholesterol reduction in the blood than red beef. Fish are also easier to keep than other meat-producing animals because they are able to convert more nutrients into protein. Therefore, his overall conversion of pounds of feed to pounds of protein makes it less expensive to raise fish because they use it more efficiently.

Seaweeds are progressively transformed into alternative fuel sources by making them produce fuels that can replace contemporary fossil fuels. Algae produce lipids which, if harvested, can be burned as an alternative fuel source, the only by-product of which would be water when burned. Such an advance could reduce the world's dependence on drilled fossil fuels, as well as reducing the price of energy by growing it instead of drilling for oil. In addition, seaweed-based fuel is a cleaner, workable energy source, which means it can help revolutionize the energy sector and create a more stable economy that avoids the explosive nature of oil and replaces it with a more abundant fuel source.

Aquaculture increases the number of potential jobs in the marketplace because it both provides new products for a market and creates employment opportunities because of the labor required to maintain the pools and harvest the cultured organisms.

Employment increases are mostly realized in third world countries, as aquaculture provides both a source of food and an additional source of income to supplement those living in these areas. Aquaculture also saves fishermen time because they do not have to spend their days fishing at sea. This gives them free time to pursue other economic activities, such as engaging in alternative businesses. This growth in entrepreneurship provides more opportunities for hiring and employment.

The seafood business in America is mainly based on trade from Asia and Europe, with the majority being imported. This results in a trade deficit for the nation. Aquaculture is one way to reduce this deficit at a lower opportunity cost, as local production would mean fresher seafood. It would be less expensive because of the reduced transportation costs.

Biosecurity

Aquaculture farms also protect biodiversity by reducing fishing activities on wild stocks in their ecosystems. By giving alternatives to fishing, **attacks on** wild populations of different species at sea are reduced. Reduced fishing action saves aquatic ecosystem diversity from extinction due to overfishing.

Disadvantages of aquaculture

Environmental impact of aquaculture

They can have an unfavorable effect on the local environment. For example, antibiotics and chemicals that are used to treat fish. Fish farms can also produce large amounts of effluent, which can affect the immediate location. Diseased fish may escape from the facility and transmit their conditions to wild stocks.

Problems in aquaculture

Some farmed fish, such as salmon, sea bass and cod, are carnivorous. In order to ensure that they grow quickly their energy needs, they must obtain large amounts of protein. This protein is often extracted from smaller baitfish, ground into pellets.

This means that wild stocks of bait fish such as sardines, mackerel, anchovies and other small fish are targeted, which impacts wild stocks.

Diseases

If aquaculture presents advantages, one should not neglect the disadvantages related to this practice. Indeed, keeping fish in close proximity increases the risk of disease. If a fish gets sick from a contagious virus, it is likely to be transferred to other fish in the farm. Fish are also vulnerable to parasite infestations. There is also a risk.

COMPREHENSIVE CHECK

Task 2. Provide Ukrainian equivalents for the following words and expressions, learn them, and use into your retelling.

Wild-catch fishing, a sustainable source, oysters, complete domestication, mussel farming, similar, Liquid manure, livestock, to stimulate, fertilizer, crustaceans, poaching, artificial ponds , to diminish, storage , to release, species, granulated food, raw meat, floating cages, breeding and rearing, shellfish, population enhancement, maturation, to absorb nutrients, to flourish, assimilated to mariculture, a ditch, coexistence, hydroponic beds, trout, salmon, char, sturgeon, advantages and disadvantages of aquaculture, efficiency, the manufacturing process, environmental constraints, cholesterol reduction, bass, cod, carnivorous, sardines, mackerel, anchovies, vulnerable to parasite infestations, extensive, intensive, a recirculating aquaculture system, purified water, non-degradable waste.

Task 3. Answer the following questuins using active vocabulary from the text.

1. What is fish farming and what is its main purpose?
2. How is fish farming different from a hatchery?
3. Why are fish farming professionals organized into unions or representative bodies?
4. What was the global revenue of fish farming in 2008 according to the FAO?
5. Why is fish farming considered to have great economic potential?
6. What is mariculture?
7. What is algaculture?
8. What are two main methods of cultivation in the production of aquaculture plants?

9. What is hydroponics?
10. What are floating plant ponds?
11. What are the advantages and disadvantages of aquaculture?
12. What are the types of aquaculture?
13. What is the cage system of fish farming, and where is it used?
14. What is the main disadvantage of the cage system?
15. How does the ditch or irrigation pond system benefit the land?
16. What makes composite fish farming unique compared to other methods?
17. Why is it important to select fish species carefully in composite farming?
18. How does the tank-based method use hydroponic beds?
19. What herbs are commonly grown in hydroponic systems connected to fish tanks?
20. What is the continuous flow system in fish farming?
21. Which freshwater fish species are commonly used in fish farming?
22. Why is rainbow trout the most widespread species in fish farming?
23. How does aquaculture help reduce pressure on wild fish populations?
24. Why is aquaculture considered more efficient than raising land animals?
25. What role can seaweed play in alternative energy production?
26. How does aquaculture contribute to job creation in developing countries?
27. In what ways can aquaculture help reduce a country's trade deficit?

Task 4. Match each term on the left with its definition on the right.

Terms	Definitions
1. Aquaculture	A. The cultivation of fish or marine plants in saltwater
2. Hatchery	B. Organisms' surrounding natural environment
3. Effluent	C. Fish or animal waste liquid
4. Mariculture	D. A method of growing plants without soil
5. Hydroponic	E. Farming of aquatic organisms
6. Biodiversity	F. The ability to be maintained over time
7. Sustainability	G. A place where fish are bred and released
8. Carnivorous	H. Animals that eat other animals
9. Nutrients	I. Variety of life in the world or a particular habitat
10. Ecosystem	J. Substances needed for growth and health

Task 5. Fill in the blanks. Use the correct word from the box.

cage, greenhouse, hatchery, algae, biodiversity, protein, antibiotics, fuel, employment, nutrients

1. A ____ is a structure where young fish are released into the wild.
2. Fish raised in tanks are often kept inside a ____.
3. Plants and ____ can naturally feed fish in ponds.
4. Fish waste provides ____ for plants in hydroponic systems.
5. Fish are rich in essential ____.
6. Seaweed can be transformed into alternative ____.
7. Aquaculture can help maintain aquatic ____.
8. Fish farmers sometimes use ____ to treat diseases.
9. Fish farming in a ____ helps control temperature and environment.
10. Aquaculture increases ____ in developing countries.

Task 6. Choose the correct **option to complete the sentence.**

1. Fish farming is a part of (agriculture / aquaculture / architecture).
2. Fish are (wild / artificially / barely) fed in cages.
3. The most common fish species is (salmon / rainbow trout / tuna).
4. Algae can be used to produce (fuel / food / plastic).
5. One risk of aquaculture is the spread of (medicine / disease / trade).
6. Farmers use fish waste as (medicine / feed / fertilizer).
7. Fish farming is considered (cheap / expensive / profitable) in the long run.
8. Composite farming uses (one / several / no) species of fish.
9. A (greenhouse / warehouse / school) can be used for pure fish farming.
10. Aquaculture is known to (increase / reduce / ignore) job opportunities.

Task 7. Write the correct form of the word in brackets.

1. Fish farming is a type of ____. (agriculture)
2. Fish are ____ fed in cages. (artificial)
3. Composite fish farming allows ____ of species. (coexist)
4. Aquaculture helps in the ____ of wild stocks. (replenish)
5. Seaweed can be used as an ____ fuel. (alternate)
6. Aquaculture helps reduce ____ costs. (transport)
7. Fish farming has great economic ____. (important)

8. ____ fish farming takes place in earthen ponds. (extensive)
9. Some fish are ____ raised for commercial purposes. (intense)
10. Aquaculture creates new job ____. (opportunity)

Task 8. Make up as more sentences as you can using the words and expressions from Task 3.

Task 9. Write a brief summary of the text. Read your summaries of the text to your groupmates.

Task 10. Make up a plan of this text. Retell the text according to it.

Task 11. Read the text and write a brief summary of the text.

AQUACULTURE AND FISH FARMING

Fish farming is a major branch of aquaculture that involves raising fish in controlled environments such as tanks, ponds, or enclosures, usually for food production. This method is the most common type of aquaculture, whereas other forms, like mariculture, focus on farming in marine environments. Facilities that release juvenile fish to support wild populations or for recreational fishing are usually called hatcheries. Fish farmers often work under national organizations or unions, which help ensure that practices are environmentally responsible and meet high standards of food quality.

Methods of Fish Farming

Method 1: Cage Culture: Fish are raised in cages placed in lakes, rivers, or oceans. They are artificially fed and harvested when mature. While technological improvements have reduced disease and environmental impact, fish escape remains a concern, as escaped fish may affect wild populations.

Method 2: Pond or Ditch SystemThis method uses ditches or irrigation ponds filled with water. On a small scale, fish are fed by hand, and their waste helps fertilize nearby farmland. On a large scale, ponds become self-sufficient, producing plants and algae that naturally feed the fish.

Method 3: Composite Fish Farming: Several compatible species (both local and exotic) are raised together in the same pond. This method minimizes competition for food and makes efficient use of available space and resources.

Method 4: Tank-Based Hydroponic System: Plastic tanks are placed inside greenhouses, with hydroponic beds nearby. Fish waste-rich water is pumped to the beds to nourish plants like basil and parsley. This is a closed-loop system combining aquaculture and agriculture.

Method 5: Continuous Flow System: Fish are raised from eggs and then released into streams. This method is commonly used to support wild populations or for sport fishing.

Various freshwater and saltwater fish species are suitable for farming. Common freshwater species include: Rainbow Trout (most popular, with over 32,000 tons produced), Fario Trout (mostly used for restocking rivers), Brook Trout, Arctic Char, Sturgeon, Carp.

Advantages of Aquaculture

1. Sustainability: Aquaculture reduces pressure on wild fish populations by offering a reliable alternative. It helps overfished species recover and provides consistent food supplies.

2. Efficiency: Fish convert food into protein more efficiently than land animals, making fish farming cost-effective and environmentally friendly.

3. Economic Benefits: Aquaculture boosts local economies by creating jobs, especially in developing countries. It also reduces reliance on imported seafood, improving trade balances.

4. Nutritional Value: Farmed fish provide a rich source of lean protein and omega-3 fatty acids, contributing to healthier diets. They are also better for heart health than red meats.

5. Clean Energy Potential: Some algae used in aquaculture produce biofuels, offering an alternative to fossil fuels. This can reduce greenhouse gas emissions and support a greener economy.

6. Biosecurity: Aquaculture protects marine ecosystems by reducing the need for wild fishing, helping preserve biodiversity and reducing extinction risks.

Disadvantages of Aquaculture

1. Environmental Concerns: Fish farms can release chemicals and antibiotics into the environment, and large amounts of waste can pollute local waters. Escaped fish may spread disease to wild populations.

2. Use of Wild Bait Fish: Carnivorous farmed fish like salmon require high-protein diets, often made from smaller wild fish (e.g., sardines, anchovies), which can harm those wild fish stocks.

3. Disease and Parasites: Fish raised in close quarters are more prone to disease outbreaks and parasite infestations, which can spread quickly and be hard to control.

UNIT 2
FISH FEED

TEXT 1
COMMERCIAL FISH FEED

Task 1. Read the text and be ready to retell it.

Manufactured feeds are an important part of modern commercial aquaculture, providing the balanced nutrition needed by farmed fish. The feeds, in the form of granules or pellets, provide the nutrition in a stable and concentrated form, enabling the fish to feed efficiently and grow to their full potential.

Many of the fish farmed more intensively around the world today are carnivorous, for example Atlantic salmon, trout, sea bass, and turbot. In the development of modern aquaculture, starting in the 1970s, fishmeal and fish oil were key components of the feeds for these species. They are combined with other ingredients such as vegetable proteins, cereal grains, vitamins and minerals and formed into feed pellets. Wheat, for example, is widely used as it helps to bind the ingredients in the pellets.

Other forms of fish feed being used include feeds made entirely with vegetable materials for species such as carp, moist feeds preferred by some species (easier to make but more difficult to store), and trash fish — that is fish caught and fed directly to larger species being raised in aquaculture pens.

Hatchery feeds

Specialised feeds are produced for fish hatcheries. In species such as salmon and trout, the newly hatched fry first feed from their yolk sacs and then can be fed with starter feeds. Marine species such as sea bass, sea bream, flounders and turbot consume the nutrition in their yolk sacs during the first few days post hatching and then are fed for several weeks on live prey,[1] in the form of rotifers and brine shrimp (Artemia). Special feeds can be used to enrich the nutritional value of the prey. Rotifers are usually bred in the hatchery while brine shrimp are generally collected from the wild, e.g. salt lakes. Manufactured feed alternatives to brine shrimp are becoming available, offering more consistent nutrition and improved sustainability as demand increases with the growth of aquaculture.

Development of manufactured feeds

Until the end of World War II most fish hatcheries relied on raw meat (horse meat in particular) as a dietary staple for trout. In the early 1950s, John E. (Red) Hanson, while working for the New Mexico Game and Fish Department, began experimenting with dietary routine and dry pellet formulations. The first fish feed pellets were introduced to hatchery trout at the Red River Hatchery near Taos. The pellets resulted in improved conversion rates of food intake to fish production, and lead in turn to the wider adoption of fish pellets in hatcheries.

The development of dry pelleted fish feeds to date has two themes. One theme is on improving digestibility and refining the balance of nutrients to match the needs of the different species of fish more precisely at different periods of development. The other theme is to improve the sustainability of the ingredients used. This is being achieved mainly by identifying additional sustainable sources of ingredients, in particular to reduce the need for fishmeal and fish oil. Improving the efficiency of feeding also contributes to sustainability.

Sustainability

Traditionally two of the most important ingredients have been fishmeal and fish oil. These come mainly from the processing of fish from the wild catch, usually pelagic species that are generally not suited to processing for human consumption. Fish sold for human consumption attract a higher price than those used to make fishmeal. The fishmeal fisheries are often referred to as reduction fisheries. The world’s largest reduction fishery is in the Pacific, off the coast of Peru and Chile and is regulated by the governments of those countries. The North Atlantic is another important source of fish for fishmeal and fish oil. Many major suppliers belong to the International Fishmeal and Fish Oil Organisation.

Fishmeal is a brown, flour-like material made by specialist producers that cook, press, dry and grind the fish. The fish oil is effectively a by-product of this process that proves to be a rich source of energy and fatty acids for fish, including the important long-chain omega-3 fatty acids EPA and DHA now linked to the health benefits associated with eating oily fish such as salmon and mackerel. Fish in general also are good sources of many vitamins and minerals and are often recommended as part of a healthy diet by governmental food agencies.

Because the catches of wild fish must be managed at sustainable levels to ensure the stocks continue to be viable, the available supply of fishmeal and fish oil from these resources will not increase.

The global demand for fish from consumers around the world is increasing. Reasons include the growing population, rising average incomes and greater awareness of fish as part of a healthy diet. The yield from the wild catch cannot be increased sustainably, therefore, in the opinion of observers such as the Food and Agriculture Organization (FAO) of the United Nations, aquaculture must fill the gap. Currently the supply of fish from aquaculture approximately matches that from the wild catch, according to FAO figures.

The current drive in research and development is enabling this to happen by supplementing fishmeal and fish oil with vegetable proteins and oils, while ensuring the fish continue to provide the important health benefits for consumers. Other potential raw material resources are also being explored. For example, the U.S. biotechnology company BioTork is piloting the use of raw materials such as unmarketable papaya and by-products from biodiesel production to produce fish feed components, as well as feeding agricultural waste to algae and fungi that manufacture some of the proteins and omega-3 oils needed for fish food. The US biotechnology company Calysta and the UK/Danish biotech company Unibio opened small plants in the UK and Denmark to produce fish feed from natural gas in 2016.

Modern fish feed

Modern fish feeds are made by grinding and mixing together ingredients such as fishmeal, vegetable proteins and binding agents such as wheat. Water is added and the resulting paste is extruded through holes in a metal plate. The diameter of the holes sets the diameter of the pellets, which can range from less than a millimetre to over a centimetre. As the feed is extruded it is cut to form pellets of the required length. The pellets are dried and oils are added. Adjusting parameters such as temperature and pressure enables the manufacturers to make pellets that suit different fish farming methods, for example feeds that float or sink slowly and feeds suited to recirculation systems. The dry feed pellets are stable for relatively long periods, for convenient storage and distribution. Feeds are delivered in bulk, in large bags - usually one tonne, or in 25 kilogram bags. Smaller quantities of specialist feeds are supplied for use in fish hatcheries. The three major manufacturers of fish feeds for aquaculture are Biomar, EWOS and Skretting.

COMPREHENSIVE CHECK

Task 2. Provide Ukrainian equivalents for the following words and expressions, learn them, and use into your retelling.

Manufacted feeds, turbot, hatchery, pellets, vegetable proteins, cereal grains, newly hatched fry, first feed, starter feeds, yolk sacs, live prey, rotifers and brine shrimp, pelagic species, fishmeal fisheries, reduction fisheries, to cook, press, dry and grind the fish, to be viable, herbivores, carnivores, omnivores, fish's behavior or mouth shape, catfish, surface feeders, to swallow, flake food, digestive problems, bloating, overfeeding, mixed-species tanks, insects, worms, roadside exhaust, freeze-dried foods, uneaten, aquaculture activities.

Task 3. Answer the following questions using active vocabulary from the text.

1. What is the main purpose of manufactured fish feed in aquaculture?
2. Which fish species are mentioned as carnivorous in the text?
3. Why is wheat used in the production of fish pellets?
4. What are trash fish, according to the text?
5. What types of feeds are used for herbivorous species like carp?
6. Why are moist feeds more difficult to store?
7. What do newly hatched salmon and trout fry feed on first?
8. What live prey are marine fish larvae fed after using up their yolk sacs?
9. How are rotifers usually produced in hatcheries?
10. What is the origin of most brine shrimp used in hatcheries?
11. What are the benefits of manufactured alternatives to brine shrimp?
12. Who was John E. (Red) Hanson, and what did he contribute to fish feed development?
13. What were early fish hatcheries using as a primary food source for trout?
14. What are the two main goals in developing modern dry pelleted fish feed?
15. What are fishmeal and fish oil primarily made from?
16. What is fishmeal, and how is it produced?
17. What are the health benefits of fish oil mentioned in the text?
18. Why can't the supply of fishmeal and fish oil be increased?
19. What role does aquaculture play according to the FAO?
20. Name two biotech companies exploring alternative fish feed ingredients.

Task 4. Fill in the blanks.

Use the correct word from the list to fill in the blanks:
(*Words: fishmeal, aquaculture, vegetable, extrusion, fry, wheat, binder, brine shrimp, moist, pellets*)

1. ____ is commonly used to help bind the ingredients in fish pellets.
2. Newly hatched fish are called ____.
3. ____ is a rich source of protein made from processed fish.

4. ____ is the farming of aquatic organisms such as fish.
5. ____ is added to the paste and pushed through holes to form pellets.
6. ____ feeds are harder to store than dry ones.
7. Many feeds now use ____ proteins to replace fishmeal.
8. Young marine fish often eat live ____.
9. ____ agents help form stable feed structures.
10. Dry ____ are easier to distribute and store.

Task 5. Choose the best word to complete each sentence.

1. The fish oil is a by-product of making ____
   a) wheat
   b) fishmeal
   c) biodiesel
2. The live prey for young sea bass includes ____
   a) fry and trout
   b) brine shrimp and rotifers
   c) wheat and barley
3. ____ helps create floating or sinking feed.
   a) Moisture
   b) Protein
   c) Temperature
4. Hatcheries for trout used to feed them with ____
   a) raw meat
   b) brine shrimp
   c) vegetable paste
5. One goal of modern feed is ____
   a) increasing fish prices
   b) reducing wild fish use
   c) making pellets heavier
6. ____ are commonly used in starter feeds.
   a) Brine shrimp
   b) Fishmeal
   c) Yolk sacs
7. Sustainable ingredients include ____
   a) trash fish
   b) gas-based proteins
   c) meat by-products

8. Fishmeal is made from ____
   a) human-grade tuna
   b) pelagic fish
   c) shrimp
9. The term “reduction fisheries” refers to ____
   a) sustainable fishing
   b) catching fish for feed
   c) overfishing
10. BioTork is working on using ____
   a) farmed trout
   b) raw papaya waste
   c) fish oil

Task 6. Use the correct form of the word. (A b**ase word is provided – convert to the correct form).**

1. Sustain → _____ (noun)
2. Feed → _____ (noun)
3. Farm → _____ (person)
4. Reduce → _____ (noun)
5. Manufacture → _____ (noun)
6. Develop → _____ (noun)
7. Bind → _____ (noun)
8. Consume → _____ (noun)
9. Regulate → _____ (noun)
10. Vary → _____ (noun)

Task 7. Choose the best matching word for each word.

1. Fish → a) eggs b) oil c) feathers
2. Pellet → a) drink b) binder c) plastic
3. Feed → a) nutrition b) clothing c) gold
4. Hatchery → a) bricks b) fry c) wheels
5. Oil → a) omega-3 b) carbon c) acid
6. Protein → a) vitamin b) bricks c) nutrition
7. Vegetable → a) pellet b) protein c) binder

8. Wild → a) managed b) uncontrolled c) cultivated
9. Grain → a) seaweed b) wheat c) shrimp
10. Technology → a) feeding b) farming c) both

Task 8. Mark true or false.

1. Fishmeal is a powder made from wild fish.
2. Brine shrimp are grown in fish hatcheries.
3. Moist feeds are easier to store than dry feeds.
4. Fish oil contains omega-3 fatty acids.
5. Vegetable proteins are used to replace fishmeal.
6. Pellets are made using extrusion.
7. Fish fry first eat rotifers.
8. Trash fish are sold for human consumption.
9. The FAO supports increasing wild fish catch.
10. Recirculation systems require special pellets.

Task 9. Match the phrase to its meaning

1. Feed conversion rate
2. Live prey
3. Hatchery fry
4. Reduction fishery
5. Sustainable ingredients
6. Binding agent
7. Raw materials
8. By-product
9. Wild catch
10. Pelleted feed

(*Meanings to match:* a) stable fish food form, b) environmental-friendly components, c) organisms eaten alive, d) young fish raised in farms, e) secondary output of a process, f) materials not processed yet, g) fish taken from the ocean, h) efficiency of food use, i) industry producing fishmeal, j) substance holding mix together*)*

Task 10. Make up as more sentences as you can using the words and expressions from Task 3.

Task 11. Write a brief summary of the text. Read your summaries of the text to your groupmates.

Task 12. Make up a plan of this text. Retell the text according to it.

Task 13. Translate into Ukrainian and write a brief summary.

Manufactured fish feeds play a vital role in modern commercial aquaculture by providing balanced nutrition in the form of pellets or granules. These feeds help farmed fish grow efficiently and reach their full potential. Carnivorous fish species like salmon, trout, sea bass, and turbot often require feeds made with fishmeal and fish oil, combined with vegetable proteins, grains like wheat (used as a binder), and vitamins. Other feed types include vegetable-based diets for species like carp, moist feeds, and raw "trash" fish used in some systems.

Hatchery feeds are specially formulated for young fish. In species like salmon and trout, fry first feed from their yolk sacs, then switch to starter feeds. Marine species like sea bass and turbot consume live prey such as rotifers and brine shrimp after yolk sac absorption. These prey can be nutritionally enriched, and manufactured alternatives to brine shrimp are being developed for better sustainability and consistency.

The development of modern dry pelleted fish feed began after World War II, particularly in the 1950s, when John E. Hanson introduced the first dry pellets to trout hatcheries. These pellets improved feeding efficiency and became widely used. Since then, improvements have focused on optimizing digestibility, species-specific nutrition, and ingredient sustainability. Replacing fishmeal and oil with more sustainable options is a key goal.

Sustainability is a major concern. Fishmeal and fish oil—traditionally essential ingredients—are sourced from wild-caught fish not suitable for human consumption. These reduction fisheries, like those off the coasts of Peru and Chile, are strictly regulated. However, wild fish stocks are limited, and their harvest cannot be increased sustainably.

As global demand for fish rises due to population growth and health awareness, aquaculture must meet the gap. This has led to innovations such as using vegetable oils and proteins and alternative sources like agricultural waste, fungi, algae, and even natural gas to produce feed components. Companies like BioTork, Calysta, and Unibio are leading these developments.

Modern fish feeds are produced by grinding ingredients (e.g., fishmeal, plant proteins, wheat), forming a paste, and extruding it into pellets of various sizes. These pellets are dried and coated with oil. Feed characteristics (such as floating or sinking) can be tailored to different farming systems. The finished products are packaged in bulk or smaller bags, with special feeds available for hatcheries. The leading producers of fish feed are Biomar, EWOS, and Skretting.

TEXT 2
HOW TO FEED FISH

Task 1. Read the text and be ready to retell it.

Dry Food to Form a Complete Diet

Three Methods: Choosing a Dry Fish Food, Feeding Your Fish Dry Food, Supplementing Dry Food to Form a Complete Diet

Feeding fish is simple once you know how. Just make sure that the dry food you are using is well suited to the fish species, as described below. Once you have found a food that works well and are feeding the fish the right amount, begin supplementing their diet with insects, vegetables, or other nutritious foods depending on the type of fish.

Method 1
Choosing a Dry Fish Food

1. **Research your fish species.** People at the store where you purchased your fish should be able to help you pick out a fish food if you cannot find information specific to your species online. Find out whether your fish are **herbivores**, **carnivores**, or **omnivores**, and ideally the exact % of protein the fish species requires in its diet. Some exotic species require special diets, but most fish can be fed basic "fish food" flakes or pellet. However, don't go rushing to the pet store yet.

2. **Find a fish food specific to your fish if possible.** Many aquarium fish are fed with a general purpose fish food, or one intended for a broad category such as "tropical fish." As long as you read this section carefully, your fish may do fine with the right type of general food. However, if you can find a fish food specific to your fish species or group of related species, your fish will most likely be healthier and happier. These should be labeled clearly as "cichlid food," "betta food," etc.

3. **Pick food that floats, sinks, or slowly sinks depending on your fish's mouth shape.** You can ask an aquarium store employee for advice if necessary, but often watching your fish's behavior or mouth shape will be enough to find out what type of food to buy. Bottom feeders such as catfish spend time at the bottom of the tank, with their down-turned or underside mouths searching for food. Mid-feeders have mouths pointing straight ahead and search for food in the middle of the tank. Surface feeders have upturned mouths and cluster to the surface when they are fed. If you are unsure what type your fish is, simply try out a food and see if they successfully find and eat it; some fish may not be restricted to one area.

– **Flake** food floats, and is only suitable for surface feeders.

– **Grain, granule, or pellet** food may float, sink slowly, or sink rapidly. Try to find more information on the label before buying.

– **Wafer** food sinks to the bottom, and is usually too large to be "stolen" by surface feeders.

– **Tablet** food can be dropped to the bottom of the tank, or, sometimes, stuck to the inside wall of the aquarium to provide food for mid-feeders.

4. **Check the protein content of the fish food.** Use the results of your research to narrow down the type of fish food to buy. Herbivores and omnivores require fish food made mostly from vegetable material, such as spirulina. Depending on species, their fish food should contain anywhere from 5% to 40% protein, so research the species thoroughly to narrow down your options. Carnivores, on the other hand require a diet between 45% and 70% protein, depending on species. Make sure the fish food you buy matches the needs of your fish.

– Bettas are carnivores and surface feeders. Their food should contain at least 45% protein, float, and be small enough to fit in the betta's mouth. Betta food is often sold in the form of tiny pellets.

– Goldfish are omnivores, and require 30% protein as adults, or 45% as young fish. Aquatic plant proteins are easiest for them to digest. They are surface feeders, so flakes are a good choice.

5. **Make sure your food is small enough for your fish to eat.** Many fish swallow their food whole, which means they are unable to break apart large flakes or pellets that do not fit inside their mouth. If the food you are giving your fish is going untouched, or if it looks bigger than your fish's mouth, crush it into pieces before feeding or find a smaller type of food.

6. **Look up fish food companies online.** Before purchasing a dry fish food, search for the brand name and reviews. Well-respected companies that get good reviews from aquarium hobbyists are more likely to make high-quality fish food.

Method 2
Feeding Your Fish Dry Food

1. **Feed in tiny portions.** While many people have heard that fish require a "pinch" of flake food each feeding, giving them too large a pinch can give the fish digestive problems or make the tank dirty and unhealthy. Whatever type of dry food you are using, only put in as much food as your fish can eat in 3 to 5 minutes. If you put too much food in the tank, scoop it out with a fine net.

Warning: Betta fish should be fed much less than they can eat in 5 minutes. Two or three small pellets per betta is sufficient.

2. **Soak pellet foods before feeding.** Because many aquarium fish have small stomachs, pellets that absorb water and expand in size may cause digestive problems or bloating in your fish. Soak the pellets in water for 10 minutes before feeding so they expand before the fish eat it, rather than in the fish's stomach.

3. **Feed the fish once or twice a day.** Because it is much easier to overfeed most fish than to give them too little food, one feeding a day may be safer. However, if you are careful to give them small amounts of food as described above, you may feed the fish twice a day. Some aquarium owners prefer this because the fish become more active and interesting to watch during feeding.

4. **Look for signs of overfeeding.** If a trail of poop is hanging from your fish, their intestine may be partially blocked due to overfeeding or the wrong type of food. If the water gets dirty enough that you need to do a water change more than once a week, you may be overfeeding the fish, or the tank may be overcrowded. Reduce the amount of food per serving or the number of servings per day to see if the problem goes away within a few days. Ask an aquarium store employee or fish raising hobbyist for advice if it does not.

5. **Spread out the food so everyone gets some.** Even within the same species, the larger or more aggressive fish may not leave enough food for the other fish. Reduce the chance of this happening by dividing the food and adding it to more than one area of the tank, or by sprinkling it evenly across the entire water surface.

6. **Watch for problems if you have multiple types of fish.** If you have fish in your tank that feed in different areas of the tank, or on different types of food, you will likely need to purchase more than one fish food. Watch mixed-species tanks closely during feeding when you start them on a new food. You may need to find different combinations of food or feeding times if the fish at the surface eat all the food intended for the fish at the bottom. If some of your fish are active during the day and others at night, feeding them at two different times may help ensure that each fish gets enough food.

7. **Consider your options while away on vacation.** Leaving adult fish alone without food for a few days is almost always safe, and if you research your fish species online you may discover they can survive without serious risk for one or two weeks. For longer trips, or for young fish with more urgent food requirements, you'll need a way to feed them while you're gone. Choose from one of the following solutions:

Method 3
Supplementing Dry Food to Form a Complete Diet

1. **Obtain these supplements from safe sources.** Insects, worms, and other animal food is most safely obtained at a pet store or aquarium store, while plant

matter should be organically grown away from roadside exhaust. If a *local* aquarium expert tells you that collecting animals or plants from outdoors is safe in your area, then you may follow her advice. Otherwise, understand that collecting these supplements yourself carries the risk of disease, parasites, or harmful chemicals.

2. **Feed carnivorous fish live or frozen animals.** One to three times a week, give your fish frozen or live insects and other animal foods instead of their usual feeding. *Always* research your fish species' needs or ask an expert before selecting a food, as some foods can transmit disease or cause digestive issues when fed to certain species. Common foods available at pet shops include bloodworms, tubifex worms, daphnia, and brine shrimp. As with any feeding, only provide tiny amounts of food; enough to eat within 30 seconds may be enough for some species.

Warning: Freeze-dried foods are another option, but should only be used occasionally due to the digestive issues large amounts can cause in some species, such as bettas.

– Avoid live tubifex worms, even ones sold at pet stores and raised on fish farms. They are known to cause diseases in many species, although the frozen variety is typically safe.

3. **Feed most fish vegetables or algae.** Herbivores and omnivores will likely be healthier and more colorful if you supplement their diet with the occasional plant matter, and even many carnivorous species can eat plants for useful nutrients. As always, research your fish species online before feeding it a new food. You can attach a piece of vegetable inside the tank with a vegetable clip, or cut it into small pieces to feed to your fish. Be sure to remove any uneaten vegetables within 48 hours, or it will start to rot in your tank.

– Carrots, zucchini, cucumbers, carrots, lettuce, and peas are just a few of the vegetables your fish might enjoy. Feed once every few days or as advised for your species.

– Using spirulina powder, infusoria, algae, or other plant matter sold at aquarium shops is another option, and a necessary one for tiny, juvenile fish too small to eat vegetable pieces. As long as the tank's surface or walls doesn't become overgrown with algae, you may add it according to instructions once or twice a day.

4. **Feed your fish a variety of these supplements for greater health.** Different animals or vegetables provide different vitamins, minerals, and other nutrients. Alternate between two or three types of animals or meat (for carnivorous fish) or vegetables (for other fish) for a better chance at providing all the requirements for healthy fish.

5. **Provide straight vitamins or minerals if you notice problems.** If your fish's bright colors fade, they become less active, or you notice other signs of poor health, your fish may be lacking certain nutrients. It's best to seek expert advice to

gain a better idea of which vitamins or minerals your fish needs, or to identify other problems. Fish may need these supplements during times of stress, such as when new fish are introduced to the tank.

– If you are raising live food yourself, or purchasing live food from pet shops, you may feed *them* mineral or vitamin supplements which then get digested by the predator fish. This technique is called "gut loading."

6. **Seek specific advice for raising newborn fish.** Newborn fish, or fish fry, are often too small to eat ordinary fish food. Because their dietary needs are often different than the adult fish, and they may require feeding every few hours, it's vital to seek specific advice based on the species. Research information online to make sure your fish fry have the best chance of survival.

- *How do I get fish to mate?*

For mollies, guppies, platies, and swordtails, just put a male and a female in the tank and leave the rest to them.

- *Will a beta fish die if not feed for four days?*

No, just be sure to get it back on a routine feeding schedule.

- *Is it okay to feed my carnivores small earthworms?*

You can feed them earthworms, but only do it if there are no artificial fertilizers or pesticides where they came from.

- *How much of the flakes do I give to fish in a bowl?*

If you look on the back of the food package, it should tell you the amount for what fish.

- *How do I breed goldfish?*

Make sure the tank is at least 20 gallons so there is enough space. Also, make sure you know how to tell a male from a female. The goldfish will usually breed in July and August.

- *Should fish ponds be in the shade?*

It depends on the fish. Also, keep in mind, if your pond is under a tree, the leaves may harbor insects that carry diseases.

- *What is the best food to use to feed fish that are in a pond?*

It depends on the type of fish you are feeding. There is no "best" food for all pond fish.

- *Can I feed vegetables to my betta fish?*

Occasionally a blanched pea (without skin) is used to prevent/cure constipation, but bettas are carnivores/insectivores and don't normally eat veggies. Bloodworms and brine shrimp are good, with daphnia having a fiber effect like a pea.

- *Can I feed my fish pieces of bread?*

No, bread contains yeast, which can cause problems for fish and in the warm, nutrient-rich water.

Tips

- If you have a large aquarium, it may be a good idea to buy multiple catfish or bottom-feeders. If you accidentally overfeed, they will usually clean the bottom of the aquarium, removing excess food and keeping your aquarium tidy.
- If you overfeed, and your fish are looking bloated, let them go without food for a day or two. If they are still bloated, feed them pieces from the inside of a pea to aid digestion.
- If you are going to hand-feed, place the food in your hand and let the fish swim up and pick the food out of your hand. Do not keep trying if the fish are shy and having trouble eating; some fish may be stressed by your attempt.

Warnings

- Be careful not to overfeed! Fish can die if you let them eat too much.
- Certain foods such as beef heart are high in fat. Your fish will love these, but they should only be given occasionally or to growing fish.
- Don't feed a fish a new type of food (such as insects or vegetables) without checking if it safe for that species. Some species may catch diseases from certain foods or have other health problems.
- If you are feeding your fish live food, you should make sure the food is healthy and parasite-free.
- Some fish will not eat flaked food if it has already been soaked in water beforehand.

COMPREHENSIVE CHECK

Task 2. Provide Ukrainian equivalents for the following words and expressions, learn them, and use into your retelling.

Maturation, to absorb nutrients, to flourish, assimilated to mariculture, a ditch, coexistence, hydroponic beds, trout, salmon, char, sturgeon, advantages and disadvantages of aquaculture, efficiency, the manufacturing process, environmental constraints, cholesterol reduction, bass, cod, carnivorous, sardines, mackerel, anchovies, vulnerable to parasite infestations, extensive, intensive, a recirculating aquaculture system, purified water, non-degradable waste.

Task 3. Answer the following questions using active vocabulary from the text.

1. What are the three main methods of feeding fish described in the text?
2. Why is it important to research your fish species before choosing food?
3. What type of food is suitable for surface feeders?
4. What is the main diet requirement for carnivorous fish?
5. Why should pellet food be soaked before feeding?
6. What can happen if you overfeed your fish?
7. How can you tell if your fish are overfed?
8. What should you do with uneaten food in the tank?
9. Why is it important to spread food across the tank?
10. What should you consider when feeding a tank with mixed species?
11. Name one way to feed your fish while you are on vacation.
12. Why should you test feeder blocks before leaving on a trip?
13. What is “gut loading” in fish feeding?
14. What are two examples of live or frozen foods for carnivorous fish?
15. Why is it risky to collect insects or plants from outside to feed your fish?
16. Which vegetables can be fed to herbivorous fish?
17. What should be done with uneaten vegetables in the tank?
18. Why should fish be fed a variety of supplements?
19. What kind of food is recommended for young or newborn fish?
20. Why should bread not be fed to fish?

Task 4. Match each fish type with the correct type of food.

1. Betta
2. Goldfish
3. Catfish
4. Guppies
5. Cichlids
6. Mollies
7. Swordtails
8. Platies
9. Bottom-feeders
10. Surface feeders

(*Types of food:* a) Flakes or pellets with plant protein (omnivorous, surface feeder), b) Flakes or small pellets (omnivorous, mid-to-surface feeder), c) Flakes or pellets with balanced plant and protein content (omnivorous), d) Species-specific pellets (depends on species; often omnivorous or carnivorous), e) Floating flakes or pellets, f) Sinking wafers or tablets (vegetable-based or protein-rich depending on species), g) Sinking wafers or pellets (bottom-feeder), h) Flakes with plant matter or algae (omnivorous), i) Flakes or pellets with plant matter (omnivorous), j) High-protein floating pellets (carnivorous, surface feeder)

Task 5. Fill in each blank with a word from the text.

1. Fish may become _____ if they are overfed.
2. It’s important to check the _____ content in fish food.
3. Fish that eat at the top of the tank are called _____ feeders.
4. _____ fish can eat both plants and meat.
5. Betta fish are _____ and prefer high-protein diets.
6. Uneaten vegetables should be _____ within 48 hours.
7. It’s better to feed fish in small _____.
8. A feeder _____ can be used during vacations.
9. Feeding live worms may introduce _____.
10. Flake food usually _____ on the surface.

Task 6. Mark true or false.

1. Goldfish are carnivores.
2. Tablet food is used only for surface feeders.
3. Overfeeding can dirty the water.
4. Freeze-dried foods should be used daily.
5. Vegetables like carrots can be given to some fish.
6. It’s safe to feed fish bread regularly.
7. A net can be used to remove excess food.
8. Feeding twice a day is never recommended.
9. Pellet food should be soaked for 10 minutes.
10. Some fish eat in the daytime, others at night.

Task 7. Categorize each food item as "Dry", "Live/Frozen", or "Vegetable".

1. Flake food
2. Brine shrimp
3. Cucumber
4. Pellets
5. Lettuce

6. Bloodworms
7. Spirulina powder
8. Wafer food
9. Carrots
10. Daphnia

Task 8. Choose the correct option to complete the sentence.

1. Fish should only eat food they can consume in ____ minutes.
   a) 10–15
   b) 3–5
   c) 7–9
2. Herbivorous fish need food with ____ protein.
   a) 70%
   b) 40–60%
   c) 5–40%
3. Overfeeding can lead to ____ problems.
   a) heating
   b) digestive
   c) sleeping
4. Vegetables must be ____ before feeding.
   a) frozen
   b) chopped
   c) soaked in milk
5. Feeding fish ____ per day is usually safe.
   a) 3 times
   b) once or twice
   c) every 5 hours
6. Bottom feeders prefer food that ____.
   a) floats
   b) slowly rises
   c) sinks
7. Bettas require food with at least ____ protein.
   a) 20%
   b) 35%
   c) 45%
8. A common sign of overfeeding is ____.
   a) color change

b) poop trail
c) fin growth

9. Tablet food can be ____ to the aquarium wall.
   a) glued
   b) stuck
   c) nailed

10. Feeder blocks should be ____ before use.
   a) painted
   b) frozen
   c) tested

Task 9. Match each term on the left with its definition on the right.

Terms	Definitions
1. Soak	A. A small, compressed piece of food light
2. Surface	B. The process of soaking in water
3. Digestive	C. Providing additional food or vitamins
4. Species	D. Swelling in the stomach area
5. Pellet	E. The top layer of water
6. Supplement	F. Container for keeping fish
7. Aquarium	G. Process of breaking down food
8. Feeder	H. Tool for providing food
9. Bloating	I. A group of related living organisms
10. Nutrition	J. Substances needed for health and energy

Task 10. Complete each sentence using a word from the text.

1. Bettas should be fed tiny_____ of food.
2. A_____ feeder helps provide food during vacations.
3. Overfeeding may cause water to become _____.
4. Use a _____ clip to hold vegetables in the tank.
5. Avoid _____ worms because they can carry disease.
6. You should always _____ food that fish don’t eat.
7. Feed your fish a _____ of vegetables and proteins.
8. Some foods should only be given as an occasional _____.
9. Young fish are called fish _____.
10. The protein _____ of food must match the fish's needs.

Task 11. Make up as more sentences as you can using the words and expressions from Task 2.

Task 12. Write a brief summary of the text. Read your summaries of the text to your groupmates.

Task 13. Make up a plan of this text. Retell the text according to it.

Task 14. Read the text and write a brief summary.

HOW TO FEED FISH WITH DRY FOOD AND CREATE A COMPLETE DIET

Feeding aquarium fish properly requires understanding their species-specific dietary needs and choosing the appropriate type of dry food. To begin with, it's important to research whether your fish are herbivores, omnivores, or carnivores. This will help you choose food with the right balance of nutrients, especially protein. Many fish can be fed general-purpose flake or pellet food, but species-specific foods such as "betta food" or "cichlid food" are usually healthier options.

It's also essential to match the type of food to how and where the fish eat. Surface feeders prefer floating flakes or pellets, mid-level feeders do better with slowly sinking granules or tablets, and bottom feeders need sinking wafers. The size of the food is another consideration—fish should be able to swallow it whole. If the pieces are too big, you can crush them before feeding.

When feeding, only give the fish a small amount they can consume in 3–5 minutes. Overfeeding can lead to digestive problems, excess waste in the tank, and poor water quality. Bettas, in particular, require only 2–3 pellets per meal. For pellet foods that expand in water, it's a good idea to soak them before feeding to prevent bloating. Most fish should be fed once or twice a day, depending on their needs and tank conditions.

If you keep multiple species in one tank, you may need to feed different types of food or use different feeding zones to ensure all fish receive enough nutrition. During vacations, adult fish can survive without food for a few days. For longer absences, automatic feeders or pre-measured portions for a caretaker can help.

To ensure a balanced and complete diet, dry food should be supplemented with additional nutritious items. Carnivorous fish benefit from live or frozen insects like bloodworms or brine shrimp once or twice a week. Herbivores and omnivores should receive occasional vegetables like peas, lettuce, or zucchini, as well as algae-based foods such as spirulina. Be cautious with live foods to avoid introducing parasites or diseases, and always obtain them from trusted sources.

Feeding a variety of supplements improves fish health, coloration, and activity. If signs of nutrient deficiency appear—such as fading colors or sluggishness—consider adding vitamin or mineral supplements. Special care must be taken for baby fish (fry), which require tiny, frequent meals and often cannot eat standard dry food.

In summary, feeding aquarium fish is not difficult, but it does require thoughtful planning. By choosing the right food, feeding in proper amounts, and supplementing with healthy extras, you can keep your fish vibrant and thriving.

UNIT 3
TROUT

TEXT 1
RAINBOW TROUT, *ONCORHYNCHUS MYKISS* (Walbaum 1792)

Other Names: Bow, Rainbow, Steelhead Trout

Task 1. Read the text and be ready to retell it.

Variable in colour - fish in lakes are mostly greenish or steely-blue above, with a silvery-white belly, usually a prominent rosy-pink stripe along the sides and small black spots on the body and fins. Individual fish in lakes may be silvery without a pink stripe. Juveniles often have dark blotches along the sides that disappear with growth. Native to western coastal drainages of North America, Rainbow trout were first introduced to Australia from New Zealand in 1894. Although an extremely popular freshwater gamefish, the introduction of Rainbow Trout into our freshwaters has severely impacted native fish populations.

Fish Classification

From the beginning, attempts have been made to understand the origins, breadth and complexity of the living world. Classification is an ongoing effort to catalogue life on the basis of evolutionary relationships. The fundamental unit of biological classification is the species, long described as a reproductively isolated population where, under normal circumstances, members only breed with one another. More recently, the species concept is of a single historical lineage having its own unique features that has maintained a separate identity from other such lineages. Classifications group organisms with common ancestry.

All described organisms have scientific names consisting of two italicised words, usually derived from Greek or Latin stems. The first, the generic name, always has the first letter capitalised and is followed by the specific name, which is entirely in lower case. Species with the same generic name are considered to be more closely related to each other than to species in another genus. Genera are, in turn, grouped together into families (whose names end in ‘idae’), families into orders (names ending in ‘iformes’), orders into classes, and so on, to the level of phylum or kingdom. Each of these groupings also implies a shared evolutionary history, in which members of a grouping, such as a family, are more closely related to each other than to members of a separate family. Although complete classifications have many levels, like subfamily or superorder, to aid our understanding of interrelationships, only species, genus, family, subphylum and phylum have regular significance to the general user.

The levels of classification treated here are: Phylum: Subphylum: Superclass: Class: Subclass: Order: Family: Genus: Species

Class *ACTINOPTERYGII*

Common name: Ray-finned fishes

The enormously diverse Actinopterygii, or the ‘ray-finned fishes’, is one of two living groups of bony fishes. The ray-finned fishes are the largest and most successful fish and vertebrate group, containing more than half of all living vertebrate species.

Although the other group, the lobe-fins (Sarcopterygii), contains only eight living species (two coelocanths and six lungfishes) it gave rise to the tetrapods - the four-legged vertebrates (including humans).

Ray-finned fishes have fins made up of membranes with bony supporting structures.They exhibit an amazing array of body forms and adaptations, allowing them to inhabit almost all aquatic environments, including extreme habitats such as mudflats, hot desert springs, subterranean caves, high altitude lakes and streams, polar seas and the depths of the abyss – environments where temperatures, salinities, pH levels, and dissolved oxygen levels may range from one extreme to another.

The fossil record of ray-finned fishes dates back to the Devonian period.

Order *SALMONIFORMES*

Common name: Salmons, Trouts

Rainbow trout	
	
Adult female rainbow trout	
Scientific classification	
Kingdom:	Animalia
Phylum:	Chordata
Class:	Actinopterygii
Order:	Salmoniformes
Family:	Salmonidae
Genus:	*Oncorhynchus*
Species:	***O. mykiss***
Binomial name	
Oncorhynchus mykiss (Walbaum, 1792)	

The rainbow trout (*Oncorhynchus mykiss*) is a trout and species of salmonid native to cold-water tributaries of the Pacific Ocean in Asia and North America. The steelhead (sometimes called "steelhead trout") is an anadromous (sea-run) form of the coastal rainbow trout (*O. m. irideus*) or Columbia River redband trout (*O. m. gairdneri*) that usually returns to fresh water to spawn after living two to three years in the ocean. Freshwater forms that have been introduced into the Great Lakes and migrate into tributaries to spawn are also called steelhead.

Adult freshwater stream rainbow trout average between 1 and 5 lb (0.5 and 2.3 kg), while lake-dwelling and anadromous forms may reach 20 lb (9 kg). Coloration varies widely based on subspecies, forms and habitat. Adult fish are distinguished by a broad reddish stripe along the lateral line, from gills to the tail, which is most vivid in breeding males.

Wild-caught and hatchery-reared forms of this species have been transplanted and introduced for food or sport in at least 45 countries and every continent except Antarctica. Introductions to locations outside their native range in the United States (U.S.), Southern Europe, Australia, New Zealand and South America have damaged native fish species. Introduced populations may affect native species by preying on them, out-competing them, transmitting contagious diseases (such as whirling disease), or hybridizing with closely related species and subspecies, thus reducing genetic purity. Other introductions into waters previously devoid of any fish species or with severely depleted stocks of native fish have created world-class sport fisheries such as the Great Lakes and Wyoming's Firehole River.

Some local populations of specific subspecies, or in the case of steelhead, distinct population segments, are listed as either threatened or endangered under the Endangered Species Act. The steelhead is the official state fish of Washington.

Taxonomy

The scientific name of the rainbow trout is *Oncorhynchus mykiss*. The species was originally named by German naturalist and taxonomist Johann Julius Walbaum in 1792 based on type specimens from the Kamchatka Peninsula in Siberia. Walbaum's original species name, *mykiss*, was derived from the local Kamchatkan name used for the fish, *mykizha*. The name of the genus is from the Greek *onkos* ("hook") and *rynchos* ("nose"), in reference to the hooked jaws of males in the mating season (the "kype").

Sir John Richardson, a Scottish naturalist, named a specimen of this species *Salmo gairdneri* in 1836 to honor Meredith Gairdner, a Hudson's Bay Company surgeon at Fort Vancouver on the Columbia River who provided Richardson with specimens. In 1855, William P. Gibbons, the curator of Geology and Mineralogy at the California Academy of Sciences, found a population and named it *Salmo iridia* (Latin: rainbow), later corrected to *Salmo irideus*. These names faded once it was determined that Walbaum's description of type specimens was conspecific and therefore had precedence. In 1989, morphological and genetic studies indicated that trout of the Pacific basin were genetically closer to Pacific salmon (*Oncorhynchus* species) than to the *Salmos* – brown trout (*Salmo trutta*) or Atlantic salmon (*Salmo salar*) of the Atlantic basin. Thus, in 1989, taxonomic authorities moved the rainbow, cutthroat and other Pacific basin trout into the genus *Oncorhynchus*. Walbaum's name had precedence, so the species name *Oncorhynchus mykiss* became the scientific name of the rainbow trout. The previous species names *irideus* and *gairdneri* were adopted as subspecies names for the coastal rainbow and Columbia River redband trout, respectively. Anadromous forms of the coastal rainbow trout (*O. m. irideus*) or redband trout (*O. m. gairdneri*) are commonly known as steelhead.

COMPREHENSIVE CHECK

Task 2. Provide Ukrainian equivalents for the following words and expressions, learn them, and use into your retelling.

Variable in colour greenish, belly, a prominent rosy-pink stripe, fins, blotches, the origins, breadth and complexity of the living world, ongoing effort, a reproductively isolated population, under normal circumstances, a single historical lineage, ancestry, the generic name, entirely, phylum, vertebrate species,coelacanths, lungfishes, tetrapods, array, mudflats, hot desert springs, subterranean caves, high altitude lakes, the abyss.

Task 3. Answer the following questions using active vocabulary from the text.

1. What is the scientific name of the rainbow trout?
2. Where is the rainbow trout originally native to?
3. What is the common name for the anadromous form of rainbow trout?
4. What year was the rainbow trout first introduced to Australia?
5. Who first described the species *Oncorhynchus mykiss*?
6. What do juvenile rainbow trout often have on their sides?
7. What is the meaning of the Greek roots of the genus *Oncorhynchus*?
8. Which other major group of bony fishes exists besides Actinopterygii?
9. What impact has the rainbow trout had on native fish populations in some regions?
10. What makes the fins of Actinopterygii distinct from those of other fish?
11. What are the defining coloration features of adult rainbow trout?
12. In what types of habitats can ray-finned fishes be found?
13. What determines the species classification in modern taxonomy?
14. Why were rainbow trout reclassified into the genus *Oncorhynchus*?
15. What is the average weight range of adult freshwater rainbow trout?

Task 4. Match each term on the left with its definition on the right.

Terms	Definitions
1. Anadromous	A. A classification group containing closely related species
2. Taxonomy	B. Brought into a new area by humans, not occurring there naturally
3. Subspecies	C. A distinct population within a species, often with slight differences
4. Genus	D. Originating naturally in a particular region or environment
5. Habitat	E. An animal that is hunted and eaten by another animal

6. Specimen	F. A fish that migrates from the sea into freshwater to spawn
7. Native	G. The gradual change in species over time through natural selection
8. Introduced	H.The science of classifying organisms into groups based on shared characteristics
9. Evolution	I. The natural environment where an organism lives
10. Prey	J. An individual example of a species used for study or display

Task 5. Write the correct form of each word in brackets to fit the sentence.

1. The rainbow trout has many _____ (color) forms.
2. Scientific _____ (classify) places the species in the genus *Oncorhynchus*.
3. These fish were _____ (origin) from North America.
4. Hatchery fish may reduce the _____ (pure) of wild stocks.
5. Steelhead are _____ (know) for their migratory behavior.
6. The fossil record provides _____ (evidence) of their evolution.
7. Their fins are _____ (support) by bony structures.
8. The _____ (introduce) of trout impacted native species.
9. It is an _____ (extreme) popular gamefish.
10. Juveniles have _____ (darkness) blotches along their sides.

Task 6. Use appropriate words from the text to complete the sentences.

1. The _____ name of a species includes both genus and species.
2. The steelhead is a _____ form of rainbow trout.
3. The first classification level above genus is _____.
4. In 1989, taxonomists revised the genus to _____.
5. Rainbow trout are part of the _____ family.
6. _____ fish can reach up to 20 pounds in weight.
7. Fins made of membranes supported by bones are found in _____ fishes.
8. Rainbow trout are often found in cold-water ____________.
9. The _____ record of Actinopterygii dates back to the Devonian.
10. The term “_____” refers to a group of related organisms.

Task 7. Choose the correct meaning of the underlined word.

1. The trout has **<u>anadromous</u>** forms.
   a) Non-migratory
   b) Migrates from sea to fresh water to spawn

c) Lives in freshwater only
d) Lives in the ocean permanently

2. The species was first **introduced** to Australia in 1894.
    a) Removed
    b) Shown in a museum
    c) Brought in from another place
    d) Naturally developed
3. Rainbow trout may **hybridize** with other species.
    a) Fight
    b) Refuse to eat
    c) Cross-breed
    d) Disappear
4. The term **genus** is part of scientific classification.
    a) A type of fish
    b) A scientific book
    c) A rank in taxonomy
    d) A location
5. This fish has **adaptations** to survive in many environments.
    a) Friends
    b) Physical changes
    c) Food sources
    d) Enemies

Task 8. Group the words into categories (Sort the following 10 words into two groups: Classification Terms / Fish Features).

1. Genus
2. Subphylum
3. Rosy-pink stripe
4. Kype
5. Species
6. Phylum
7. Fins
8. Class
9. Order
10. Lateral line

Task 9. Odd one out (Identify the word that doesn't belong in each group).

1. Trout – Salmon – Steelhead – Tiger
2. Fin – Gills – Bones – Leaf
3. Phylum – Class – Color – Order
4. Freshwater – Ocean – River – Tree
5. Salmonidae – Oncorhynchus – Rainbow – Reptile
6. Taxonomy – Classification – Biology – Cooking
7. Anadromous – Migratory – Stationary – Sea-run
8. Subspecies – Type – Group – Banana
9. Membrane – Ray – Bone – Wing
10. Introduced – Native – Foreign – Historical

Task 10. Mark true or false.

1. A "subspecies" is a smaller group within a species.
2. "Genus" is a classification level below "species".
3. "Ray-finned" refers to the shape of the fish's tail.
4. The "lateral line" is a sensory organ along a fish's side.
5. "Hybridize" means to fight between species.
6. "Introduced species" naturally evolved in their new environment.
7. "Kype" refers to a fish's spawning behavior.
8. "Anadromous" species move from saltwater to freshwater to breed.
9. "Taxonomy" is related to naming and classifying organisms.
10. A "specimen" can refer to an example used in scientific study.

Task 11. Make up as more sentences as you can using the words and expressions from Task 2.

Task 12. Write a brief summary of the text. Read your summaries of the text to your groupmates.

Task 13. Make up a plan of this text. Retell the text according to it.

TEXT 2

SUBSPECIES

Task 1. Read the text and be ready to retell it.

Subspecies of *Oncorhynchus mykiss* are listed below as described by fisheries biologist Robert J. Behnke (2002).

Geographical group	Common name	Scientific name	Range	Image
Type subspecies	Kamchatkan rainbow trout	*O. m. mykiss* (Walbaum, 1792)	Western Pacific: Kamchatka Peninsula, and has been recorded from the Commander Islands east of Kamchatka, and sporadically in the Sea of Okhotsk, as far south as the mouth of the Amur River	
Coastal forms	Coastal rainbow trout	*O. m. irideus* (Gibbons, 1855)	Pacific Ocean tributaries from Aleutian Islands in Alaska south to Southern California. Anadromous forms are known as steelhead, freshwater forms as rainbow trout.	 Ocean and fresh water forms of coastal rainbow trout; aka "steelhead" *O. m. irideus*
	Beardslee trout	*O. m. irideus* var. *beardsleei* (not a true subspecies, but a genetically unique lake-dwelling variety of coastal rainbow trout) (Jordan, 1896)	Isolated in Lake Crescent, Washington	
Redband forms	Columbia River redband trout	*O. m. gairdneri* (Richardson, 1836)	Found in the Columbia River and its tributaries in Montana, Washington and Idaho. Anadromous forms are known as redband steelhead.	 Columbia River redband trout *O. m. gairdneri*
	Athabasca rainbow trout	*O. m. spp.*, considered by Behnke as a form of *O. m. gairdneri*, but considered a separate subspecies by biologist L. M. Carl of the	Distributed throughout the headwaters of the Athabasca River system in Alberta	

		Ontario Ministry of Resources, Aquatic Ecosystems Research Section and associates from work published in 1994.		
	McCloud River redband trout	*O. m. stonei* (Jordan, 1894)	Native to the McCloud River, upstream of Middle Falls, and its tributaries in Northern California, south of Mount Shasta.	
	Sheepheaven Creek redband trout	*O. m.* spp.	Native to Sheepheaven Creek, Siskiyou County, California. Sheepheaven Creek redband were transplanted into Swamp Creek in 1972 and 1974 and into Trout Creek in 1977.	
	Great Basin redband trout	*O. m. newberrii* (Girard, 1859)	Native in southeastern Oregon and parts of California and Nevada on the periphery of the Great Basin.	
	Eagle Lake trout	*O. m. aquilarum* (Snyder, 1917)	Endemic to Eagle Lake in Lassen County, California.	
	Kamloops rainbow trout	*O. m. kamloops strain* (Jordan, 1892)	Native to several large British Columbia lakes, particularly Kamloops Lake and Kootenay Lake. Known for its very large size.	
Kern River golden trout	Golden trout	*O. m. aguabonita* (Jordan, 1892)	Native to Golden Trout Creek (tributary to the Kern River), Volcano Creek (tributary to Golden Trout Creek), and the South Fork Kern River.	 Kern River golden trout *O. m. aguabonita*
	Kern River rainbow trout	*O. m. gilberti* (Jordan, 1894)	Endemic to the Kern River and tributaries in Tulare County, California. Its current range is drastically reduced from its historic range. Remnant populations live in the Kern River above Durrwood Creek, in upper Ninemile, Rattlesnake and Osa creeks, and possibly in upper Peppermint Creek.	
	Little Kern golden trout	*O. m. whitei* (Evermann, 1906)	Endemic to about 100 miles (160 km) of the Little Kern River and tributaries. Their	

			current range is restricted to five headwater streams in the Kern River basin (Wet Meadows, Deadman, Soda Spring, Willow, Sheep and Fish creeks) plus an introduced population in Coyote Creek, a tributary of the Kern River.	
Mexico forms	Mexican rainbow trout Rio Yaqui, Rio Mayo and Guzman trout Rio San Lorenzo and Arroyo la Sidra trout Rio del Presidio trout	*O. m. nelsoni* (Evermann, 1908)	Sometimes referred to as Nelson's trout, occurs in three distinct geographic groups. The taxonomy of these trout is subject to ongoing research and there may be significant diversity of forms in this group.	
Mutated forms	Golden rainbow trout Palomino trout	So-called golden rainbow trout or palomino trout are bred from a single mutated color variant of *O. mykiss* that originated in a West Virginia fish hatchery in 1955. Golden rainbow trout are predominantly yellowish, lacking the typical green field and black spots but retaining the diffuse red stripe. The palomino trout is a mix of golden and common rainbow trout, resulting in an intermediate color. The golden rainbow trout is not the same subspecies as the naturally occurring *O. m. aguabonita*, the Kern River golden trout of California.		 Golden rainbow trout

Description

Resident freshwater rainbow trout adults average between 1 and 5 lb (0.5 and 2.3 kg) in riverine environments, while lake-dwelling and anadromous forms may reach 20 lb (9 kg). Coloration varies widely between regions and subspecies. Adult freshwater forms are generally blue-green or olive green with heavy black spotting over the length of the body. Adult fish have a broad reddish stripe along the lateral line, from gills to the tail, which is most pronounced in breeding males.The caudal fin is squarish and only mildly forked. Lake-dwelling and anadromous forms are usually more silvery in color with the reddish stripe almost completely gone. Juvenile rainbow trout display parr marks (dark vertical bars) typical of most salmonid juveniles. In some redband and golden trout forms parr marks are typically retained into adulthood. Some coastal rainbow trout (*O. m. irideus*) and Columbia River redband trout (*O. m. gairdneri*) populations and cutbow hybrids may also display reddish or pink throat markings similar to cutthroat trout. In many regions, hatchery-bred trout can be distinguished from native trout via fin clips.

Life cycle

Rainbow trout, including steelhead forms, generally spawn in early to late spring (January to June in the Northern Hemisphere and September to November in the Southern Hemisphere) when water temperatures reach at least 42 to 44 °F (6 to 7 °C). The maximum recorded lifespan for a rainbow trout is 11 years.

Freshwater life cycle

Freshwater resident rainbow trout usually inhabit and spawn in small to moderately large, well oxygenated, shallow rivers with gravel bottoms. They are native to the alluvial or freestone streams that are typical tributaries of the Pacific basin, but introduced rainbow trout have established wild, self-sustaining populations in other river types such as bedrock and spring creeks. Lake resident rainbow trout are usually found in moderately deep, cool lakes with adequate shallows and vegetation to support production of sufficient food sources. Lake populations generally require access to gravelly bottomed streams to be self-sustaining.

Spawning sites are usually a bed of fine gravel in a riffle above a pool. A female trout clears a redd in the gravel by turning on her side and beating her tail up and down. Female rainbow trout usually produce 2000 to 3000 4-to-5-millimetre (0.16 to 0.20 in) eggs per kilogram of weight. During spawning, the eggs fall into spaces between the gravel, and immediately the female begins digging at the upstream edge of the nest, covering the eggs with the displaced gravel. As eggs are released by the female, a male move alongside and deposit milt (sperm) over the eggs to fertilize them. The eggs usually hatch in about four to seven weeks although the time of hatching varies greatly with region and habitat. Newly hatched trout are called sac fry or alevin. In approximately two weeks, the yolk sac is completely consumed and fry commence feeding mainly on zooplankton. The growth rate of rainbow trout is variable with area, habitat, life history and quality and quantity of food. As fry grow, they begin to develop "parr" marks or dark vertical bars on their sides. In this juvenile stage, immature trout are often called "parr" because of the marks. These small juvenile trout are sometimes called fingerlings because they are approximately the size of a human finger. In streams where rainbow trout are stocked for sport fishing and no natural reproduction occurs, some of the stocked trout may survive and grow or "carryover" for several seasons before they are caught or perish.

Steelhead life cycle

The oceangoing (anadromous) form, including those returning for spawning, is known as steelhead in Canada and the U.S. In Tasmania they are commercially propagated in sea cages and are known as **ocean trout**, although they are the same species.

Like salmon, steelhead return to their original hatching grounds to spawn. Similar to Atlantic salmon, but unlike their Pacific Oncorhynchus salmonid kin, steelhead are iteroparous (able to spawn several times, each time separated by months) and make several spawning trips between fresh and salt water, although fewer than 10 percent of native spawning adults survive from one spawning to another. The survival rate for introduced populations in the Great Lakes is as high as 70 percent. As young steelhead transition from freshwater to saltwater, a process called "smoltification" occurs where the trout undergoes physiological changes to allow it to survive in sea water. There are genetic differences between freshwater and steelhead populations that may account for the smoltification in steelheads.

Juvenile steelhead may remain in the river for one to three years before smolting and migrating to sea. Individual steelhead populations leave the ocean and migrate into their freshwater spawning tributaries at different times of the year. Two general forms exist—"summer-run steelhead" and "winter-run steelhead". Summer-run fish leave the ocean between May and October, before their reproductive organs are fully mature. They mature in fresh water while en route to spawning grounds where they spawn in the spring. Summer-run fish generally spawn in longer, more inland rivers such as the Columbia River. Winter-run fish are ready to spawn when they leave the ocean, typically between November and April, and spawn shortly after returning to fresh water. Winter-run fish generally spawn in shorter, coastal rivers typically found along the Olympic Peninsula and British Columbia coastline, and summer-run fish are found in some shorter, coastal streams. Once steelhead enter riverine systems and reach suitable spawning grounds, they spawn just like resident freshwater rainbow trout.

Feeding

Rainbow trout are predators with a varied diet and will eat nearly anything they can capture. They are not as piscivorous or aggressive as brown trout or chars. Rainbow trout, including juvenile steelhead in fresh water, routinely feed on larval, pupal and adult forms of aquatic insects (typically caddisflies, stoneflies, mayflies and aquatic diptera). They also eat fish eggs and adult forms of terrestrial insects (typically ants, beetles, grasshoppers and crickets) that fall into the water. Other prey includes small fish up to one-third of their length, crayfish, shrimp, and other crustaceans. As rainbow trout grow, the proportion of fish consumed increases in most populations. Some lake-dwelling forms may become planktonic feeders. In rivers and streams populated with other salmonid species, rainbow trout eat varied fish eggs, including those of salmon, brown and cutthroat trout, mountain whitefish and the eggs of other rainbow trout. Rainbows also consume decomposing flesh from carcasses of other fish. Adult steelhead in the ocean feed primarily on other fish, squid and amphipods.

Range

The native range of Oncorhynchus mykiss is in the coastal waters and tributary streams of the Pacific basin, from the Kamchatka Peninsula in Russia, east along the Aleutian Islands, throughout southwest Alaska, the Pacific coast of British Columbia and southeast Alaska, and south along the west coast of the U.S. to northern Mexico. It is claimed that the Mexican forms of Oncorhynchus mykiss represent the southernmost native range of any trout or salmon (Salmonidae), though the Formosan landlocked salmon (O. masou formosanus) in Asia inhabits a similar latitude. The range of coastal rainbow trout (O. m. irideus) extends north from the Pacific basin into tributaries of the Bering Sea in northwest Alaska, while forms of the Columbia River redband trout (O. m. gairdneri) extend east into the upper Mackenzie River and Peace River watersheds in British Columbia and Alberta, Canada, which eventually drain into the Beaufort Sea, part of the Arctic Ocean. Since 1875, the rainbow trout has been widely introduced into suitable lacustrine and riverine environments throughout the United States and around the world. Many of these introductions have established wild, self-sustaining populations.

COMPREHENSIVE CHECK

Task 2. Provide Ukrainian equivalents for the following words and expressions, learn them, and use into your retelling.

Caudal fin, squarish, cutbow hybrids, moderately, oxygenated, alluvial or freestone streams, to be self-sustaining, the upstream edge of the nest, to fertilize, immature trout, fingerlings, commercially propagated, iteroparous, the survival rate, smolting and migrating, summer-run fish, winter-run fish, piscivorous, routinely, pupal, caddisflies, stoneflies, mayflies and aquatic diptera, terrestrial insects, ants, beetles, grasshoppers, crickets, lake-dwelling forms, planktonic feeders, carcasses..

Task 3. Answer the following questions using active vocabulary from the text.

1. What is the scientific name of the rainbow trout?
2. Which subspecies of *Oncorhynchus mykiss* is native to Kamchatka?
3. What is the difference between steelhead and freshwater rainbow trout?
4. Where is the Beardslee trout found?
5. What name is given to the anadromous form of the Columbia River redband trout?
6. Which subspecies is known for its large size and found in British Columbia lakes?
7. What is the main habitat for freshwater resident rainbow trout?
8. What is the spawning behavior of female rainbow trout?
9. How many eggs does a female rainbow trout produce per kilogram?
10. What does "smoltification" refer to?
11. What are the two types of steelhead runs?
12. Which steelhead type matures in freshwater?
13. Name three types of aquatic insects rainbow trout feed on.
14. What is the native range of *Oncorhynchus mykiss*?
15. Where can parr marks still be seen in adult trout?
16. What makes golden rainbow trout genetically different from O. m. aguabonita?
17. Which trout is endemic to the Kern River and its tributaries?
18. In what year was the golden rainbow trout color variant first bred?
19. What causes the physiological change for steelhead to survive in seawater?
20. How does the coloration of lake-dwelling trout differ from river trout?

Task 4. Choose the best definition.

1. Redd
   - a) A food type
   - b) A nesting site for trout
   - c) A fin mark
   - d) A river pool
2. Anadromous
   - a) Lives only in lakes
   - b) Migrates to ocean
   - c) Returns to freshwater to breed
   - d) Feeds on algae
3. Smolt
   - a) A small adult trout

b) A juvenile trout preparing for saltwater
c) An egg-laying female
d) A trout species

4. Tributary
a) Main river
b) River that flows into another
c) Fish nesting site
d) Ocean water

5. Endemic
a) Found worldwide
b) Introduced by humans
c) Naturally occurring in a specific place
d) Artificially bred

6. Iteroparous
a) Spawns only once
b) Eats vegetation
c) Can spawn multiple times
d) Cannot reproduce

7. Larval
a) Adult form
b) Post-spawning
c) Immature stage
d) Egg phase

8. Morphology
a) Color pattern
b) External form and structure
c) Eating behavior
d) Breeding site

9. Hybrid
a) Wild fish
b) A fish with two parents from different species
c) Saltwater only fish
d) Subspecies fish

10. Subspecies
a) Smaller fish
b) A separate species
c) A population within a species
d) A fish that has mutated

Task 5. Fill in the blank.

1. The female trout prepares a nesting area called a _____.
2. Steelhead trout undergo _____ to survive in saltwater.
3. A stream flowing into a larger river is a _____.
4. _____ trout are found only in specific native areas.
5. The term _____ means a fish can spawn more than once.
6. Trout eggs hatch into a stage called _____.
7. The _____ marks help identify juvenile trout.
8. Trout often feed on _____ insects like caddisflies and mayflies.
9. The trout's red lateral stripe is more visible during _____.
10. Golden rainbow trout are bred from a _____ mutation.

Task 6. Match each term on the left with its definition on the right.

Terms	Descriptions
1. Redd	A. Earliest development stage
2. Parr marks	B. Physical structure
3. Anadromous	C. Smaller river feeding into a larger one
4. Iteroparous	D. Mix of two species
5. Endemic	E. Juvenile trout ready for ocean life
6. Smolt	F. Native to a specific area
7. Hybrid	G. Spawns multiple times in life
8. Larval	H. Trout nest site
9. Morphology	I. Dark bars on juvenile trout
10. Tributary	J. Moves from sea to freshwater to spawn

Task 7. Mark true or false.

1. A "redd" is the place where trout eggs are hatched.
2. "Parr" refers to adult trout.
3. "Endemic" means a species is found only in one area.
4. Steelhead are always freshwater fish.
5. Morphology describes the internal organs of a trout.
6. Golden rainbow trout are a natural subspecies.
7. Iteroparous fish spawn multiple times.
8. Smoltification prepares fish for ocean life.
9. Tributaries are always larger than the main river.
10. Alevin is another word for egg.

Task 8. Sort the terms into 2 categories: *Life Cycle Terms* vs *Habitat Terms.*
Terms: smolt, tributary, spawning, riffle, alevin, endemic, redd, stream, parr, gravel

Task 9. Write a short definition based on the context clues in the text.

1. Anadromous
2. Redband
3. Hybrid
4. Introduced species
5. Golden rainbow trout
6. Spawning
7. Alevin
8. Morphology
9. Endemic
10. Iteroparous

Task 10. Group the following subspecies into geographic categories.

Subspecies:
Columbia River redband, Beardslee, Golden trout, Eagle Lake, Kamloops, Little Kern, Mexican rainbow, Athabasca, McCloud River redband.

Region	Subspecies
Pacific Northwest	
California	
Canada	
Mexico	

Task 11. Make up as more sentences as you can using the words and expressions from Task 2.

Task 12. Write a brief summary of the text. Read your summaries of the text to your groupmates.

Task 13. Make up a plan of this text. Retell the text according to it.

TEXT 3
ARTIFICIAL PROPAGATION

Task 1. Read the text and be ready to retell it.

U.S. Fish and Wildlife Service fish hatchery

Since 1870, rainbow trout have been artificially propagated in fish hatcheries to restock streams and to introduce them into non-native waters. The first rainbow trout hatchery was established on San Leandro Creek, a tributary of San Francisco Bay, in 1870, and trout production began in 1871. The hatchery was stocked with the locally native rainbow trout, and likely steelhead of the coastal rainbow trout subspecies (*O. m. irideus*). The fish raised in this hatchery were shipped to hatcheries out of state for the first time in 1875, to Caledonia, New York, and then in 1876 to Northville, Michigan. In 1877, another California rainbow trout hatchery, the first federal fish hatchery in the National Fish Hatchery System, was established on Campbell Creek, a McCloud River tributary. The McCloud River hatchery indiscriminately mixed coastal rainbow trout eggs with the eggs of local McCloud River redband trout (*O. m. stonei*). Eggs from the McCloud hatchery were also provided to the San Leandro hatchery, thus making the origin and genetic history of hatchery-bred rainbow trout somewhat diverse and complex. In the U.S., there are hundreds of hatcheries operated by the U.S. Fish and Wildlife Service and various state agencies and tribal governments propagating rainbow trout for conservation and recreational sport fishing. Six of ten Canadian provinces have rainbow trout farms, with Ontario leading production.

Aquaculture

Rainbow trout are commercially farmed in many countries throughout the world. The practice began in the late 19th century, and since the 1950s commercial production has grown dramatically. Worldwide, in 2007, 604,695 tonnes (595,145 long tons; 666,562 short tons) of farmed rainbow trout were harvested with a value of about US $2.6 billion. The largest producer is Chile. In Chile and Norway, sea cage production of steelhead has expanded to supply export markets. Inland production of rainbow trout to supply domestic markets has increased in countries such as Italy, France, Germany, Denmark and Spain. Other significant trout-producing countries include the U.S., Iran, the United Kingdom, and Lesotho. While the U.S. rainbow trout industry as a whole is viewed as ecologically responsible, trout raised elsewhere are not necessarily farmed with the same methods.

About three-quarters of U.S. production comes from Idaho, particularly the Snake River area, due in part to the quality and temperature of the water available there. California and Washington also produce significant amounts of farmed trout. In the east, Pennsylvania, North Carolina and West Virginia have farming operations. Rainbow trout farming is one of the largest finfish aquaculture industries in the U.S. They are raised inland in facilities where raceways or ponds have continuously flowing water with little pollution and a low risk of escape. The U.S. industry is noted for using best management practices. Imports constitute only about 15 percent of farmed rainbows sold in the U.S., and nearly all domestic production is consumed within the country; very little is exported. The U.S. produces about 7 percent of the world's farmed trout. Rainbow trout, especially those raised in farms and hatcheries, are susceptible to enteric redmouth disease. A considerable amount of research has been conducted on redmouth disease, given its serious implications for rainbow trout farming. The disease does not infect humans.

Conservation

Populations of many rainbow trout subspecies, including anadromous forms (steelhead) of *O. m. irideus* (coastal rainbow trout) and *O. m. gairdneri* (Columbia River redband trout) have declined in their native ranges due to over-harvest, habitat loss, disease, invasive species, pollution and hybridization with other subspecies, and some introduced populations, once healthy, have declined for the same reasons. As a consequence, some rainbow populations, particularly anadromous forms within their native range, have been classified as endangered, threatened or species of special concern by federal or state agencies. Rainbow trout, and subspecies thereof, are currently a U.S. Environmental Protection Agency-approved indicator species for acute fresh water toxicity testing.

Many non-profit organizations have formed to protect, conserve and restore native rainbow trout and steelhead populations. Generally, in partnership with various universities, state, federal and tribal agencies and private interests, these organizations sponsor projects to restore habitat, prevent habitat loss and promote awareness of threats to native trout populations.

Trout Unlimited (TU) is a non-profit organization dedicated to the conservation of North American freshwater streams, rivers, and associated upland habitats for trout, salmon, other aquatic species and people. A typical TU project is the Circle Creek Fish Passage Project, in which access to a spawning stream is being improved for steelhead and other salmonid species The Wild Salmon Center. Other high-profile organizations involved in rainbow trout conservation include California Trout, which protects wild trout and other salmonids in the waters of California. The Steelhead Society of British Columbia promotes the wellbeing of wild salmonids in British Columbia. In 1997, a group of approximately 40 ichthyologists, biologists and naturalists from several U.S. and Mexican institutions formed a collaborative group—Truchas Mexicanas—to study the diversity of Mexican native trout, most of which are considered subspecies of *O. mykiss*.

Hybridization and habitat loss

Rainbow trout, primarily hatchery-raised fish of the coastal rainbow trout subspecies (*O. m. irideus*) introduced into waters inhabited with cutthroat trout, will breed with cutthroats and produce fertile hybrids called cutbows. In the case of the westslope cutthroat trout (*O. clarki lewisi*), hybridization with introduced rainbow and Yellowstone cutthroat trout (*O. clarki bouvieri*) is threatening the westslope cutthroat trout with genomic extinction. Such introductions into the ranges of redband trout (*O. m. gairdneri, newberrii*, and *stonei*) have severely reduced the range of pure stocks of these subspecies, making them "species of concern" in their respective ranges.

Within the range of the Kern River golden trout of Southern California, hatchery-bred rainbows introduced into the Kern River have diluted the genetic purity of the Kern River rainbow trout *(O. m. gilberti)* and golden trout *(O. m. aguabonita)* through intraspecific breeding. The Beardslee trout, (*O. m. irideus* var. *beardsleei*), a genetically unique lake-dwelling variety of the coastal rainbow trout that is isolated in Lake Crescent (Washington), is threatened by the loss of its only spawning grounds in the Lyre River to siltation and other types of habitat degradation.

Uses: Fishing

Rainbow trout and steelhead are highly regarded game fish. Rainbow trout are a popular target for fly fishers, and several angling methods are used. The use of lures presented via spinning, casting or trolling techniques is common. Rainbow trout can also be caught on various live and dead natural baits. The International Game Fish Association recognizes the world record for rainbow trout as a fish caught on Saskatchewan's Lake Diefenbaker by Sean Konrad on September 5, 2009. The fish weighed 48 lb (22 kg) and was a genetically modified hatchery escapee. Many anglers consider the rainbow trout the hardest-fighting trout species, as this fish is known for leaping when hooked and putting up a powerful struggle. It is considered one of the top five sport fish in North America and the most important game fish west of the Rocky Mountains.

There are tribal commercial fisheries for steelhead in Puget Sound, the Washington coast and in the Columbia River, but there has been controversy regarding over-harvesting of native stocks. The highly desirable sporting qualities and adaptability of the rainbow trout to hatchery rearing and new habitats resulted in it being introduced to many countries around the world by or at the behest of sport fishermen. Many of these introductions have resulted in environmental and ecological problems, as the introduced rainbow trout disrupt local ecosystems and outcompete or eat indigenous fishes. Other introductions to support sport angling in waters either devoid of fish or with seriously depleted native stocks have created world-class fisheries such as in the Firehole River in Yellowstone National Park, and in the Great Lakes.

As food

Rainbow trout is popular in Western cuisine; both wild-caught and farmed fish are eaten. It has tender flesh and a mild, somewhat nutty flavor. Wild fish has a stronger, gamier taste than farmed fish. While the taste of wild-caught trout is often promoted as superior, it is illegal to sell or market wild-caught rainbow trout, which are legally classified as game fish, in the United States. Thus, rainbow trout and "steelhead" sold in American restaurants is farmed. Farmed rainbow are considered one of the safest fish to eat and are noted for high levels of vitamin B and a generally appealing flavor. Seafood Watch ranks farmed rainbow as a "Best Choice" fish for human consumption.

The color and flavor of the flesh depends on the diet and freshness of the trout. Farmed trout and some populations of wild trout, especially anadromous steelhead, have reddish or orange flesh as a result of high astaxanthin levels in their diets.

Astaxanthin is a powerful antioxidant that may be from a natural source or a synthetic trout feed. Rainbow trout raised to have pinker flesh from a diet high in astaxanthin are sometimes sold in the U.S. with labeling calling them "steelhead". As wild steelhead are in decline in some parts of their range, farmed rainbow are viewed as a preferred alternative. In Chile and Norway, rainbow trout farmed in saltwater sea cages are sold labeled as steelhead.

Trout can be cooked as soon as they are cleaned, without scaling, skinning or filleting. If cooked with the skin on the meat tends to hold together better. While trout sold commercially in Europe is often prepared and served this way, most trout sold commercially in the U.S. have had heads removed and have been fully or partially deboned and filleted. Medium to heavy bodied white wines, such as chardonnay, sauvignon blanc or pinot gris are typical wine pairings for trout.

Management Considerations

In 1896, the U.S. Commission of Fisheries introduced rainbow trout into South Dakota. Black Hills streams received 11,900 fingerling- sized fish that first year. The rainbow trout fishery in South Dakota is known as a hatchery-sustained put-and-take. In other words, the population would be negligible or non-existent without stocking. A put-and-take fishery is characterized by rapid catching of stocked fish that have not grown appreciably since stocking. Generally, these areas are stocked with "catchable" size fish.

Rainbow trout were stocked into Oahe Reservoir and its tailwaters to add diversity to that coldwater fishery. In Oahe, the rainbows prefer temperatures of 55 to 60 F (13-16 C). That is the temperature found at about a depth of 30 feet (9 m). Chinook salmon prefer cooler temperatures and are found much deeper, at around 80 feet (24 m). Tailwaters of Lake Oahe maintain suitable temperatures and oxygen levels for trout growth and year around survival, but lack suitable spawning or nursery habitat for natural reproduction. This area is stocked as a put-grow-and-take fishery, which relies on stocking of fingerlings that will have a chance to grow in the cold nutrient-rich tailwater releases.

Decisions on whether to stock or not to stock are based on information collected and analyzed by fishery biologists. In many places in the Black Hills, where there are good populations of wild trout, hatchery trout are not stocked. Anglers who prefer catching wild trout often worry that undue emphasis on trout in the creel and on stocking programs, will result in the neglect of natural resources. Biologists and fishery managers understand the value of wild trout and of the habitat that supports them. Efforts are being made by fishery managers to improve habitat so more wild trout can be produced, and fewer fish will be raised in hatcheries.

COMPREHENSIVE CHECK

Task 2. Provide Ukrainian equivalents for the following words and expressions, learn them, and use into your retelling.

Artificially propagated, to restock streams, non-native waters, a tributary, the National Fish Hatchery System, indiscriminately, state agencies and tribal governments, conservation, recreational sport fishing, susceptible to, a non-profit organization, dedicated, the Circle Creek Fish Passage Project, a spawning stream, ichthyologists, biologists, naturalists, a collaborative group, angling methods, anglers, tribal commercial fisheries, controversy, adaptability, human consumption, scaling, skinning, filleting, a hatchery-sustained put-and-take, a put-and-take fishery, fingerlings, cold nutrient-rich tailwater releases.

Task 3. Answer the following questions using active vocabulary from the text.

1. When and where was the first rainbow trout hatchery established?
2. What was the primary purpose of early trout hatcheries?
3. Why is the genetic history of hatchery-bred rainbow trout considered complex?
4. Which U.S. state leads in rainbow trout production?
5. What are raceways or ponds used for in trout farming?
6. Why is Idaho ideal for rainbow trout farming?
7. What disease commonly affects farmed rainbow trout?
8. Which country is the largest producer of farmed rainbow trout?
9. Why are steelhead populations considered threatened or endangered in some areas?
10. What organization is involved in habitat restoration for steelhead?
11. How does hybridization with cutthroat trout affect native trout species?
12. What is a “cutbow”?
13. What are the environmental risks of introducing rainbow trout to non-native waters?
14. Why is wild rainbow trout not sold in U.S. markets?
15. What contributes to the reddish flesh color in some trout?
16. What does a “put-and-take” fishery mean?
17. How do water temperature preferences differ between rainbow trout and Chinook salmon?
18. Why are tailwaters suitable for rainbow trout survival but not for natural reproduction?
19. What is a growing focus of fishery managers in areas with wild trout populations?

Task 4. Provide a brief definition based on the text.

1. Hatchery
2. Aquaculture
3. Anadromous
4. Hybridization
5. Conservation
6. Tailwater
7. Put-and-take fishery
8. Raceways
9. Enteric redmouth disease
10. Habitat degradation

Task 5. Fill in the blank.

1. The first trout hatchery began operation in _____.
2. Trout farming is a type of _____ production.
3. Trout raised in captivity are more likely to contract _____ disease.
4. _____ is the U.S. state where most farmed trout come from.
5. Trout that migrate between freshwater and saltwater are called _____.
6. Fertile offspring of rainbow and cutthroat trout are known as _____.
7. _____ loss is a key threat to native trout.
8. Farmed trout flesh is often pink due to _____ in their diet.
9. _____ water systems are used in U.S. trout aquaculture.

Task 6. Choose the best answer.

1. What is the main purpose of a fish hatchery?
   a) Research only
   b) Natural habitat protection
   c) Artificial fish breeding and stocking
   d) Aquatic museum
2. Which of the following is a type of habitat degradation?
   a) Clean water
   b) Siltation
   c) Oxygenation
   d) Shade cover
3. What is "put-and-grow-and-take" fishery?
   a) Wild fish only

b) Stocking adults for harvest
c) Fingerlings are stocked to grow before harvest
d) Fish stocked then removed

4. Where do rainbow trout prefer to live in Lake Oahe?
a) On the surface
b) 80 feet deep
c) In vegetation
d) 30 feet deep

5. What is the diet supplement that causes pink trout flesh?
a) Omega-3
b) Vitamin B
c) Astaxanthin
d) Chlorophyll

6. What is a raceway used for in trout farming?
a) Sports competition
b) Water filtering
c) Controlled fish rearing
d) Transporting fish

7. What kind of fishery depends entirely on restocking?
a) Wild habitat
b) Put-and-take
c) Marine
d) Coastal

8. What do fishery biologists use to make stocking decisions?
a) Public opinion
b) Weather data
c) Scientific information
d) Hatchery inventory

Task 7. Match each term on the left with its definition on the right.

Terms	Definitions
1. Astaxanthin	A. Artificial breeding facility for fish
2. Hybridization	B. Channels used in fish farming
3. Conservation	C. Farming of aquatic organisms
4. Aquaculture	D. Protection of natural fish populations
5. Raceways	E. Water released below a dam
6. Hatchery	F. Mixing of genes between species
7. Enteric redmouth disease	G. Illness affecting captive trout
8. Tailwater	H. Pigment used in trout diets

Task 8. Identify the Category. Sort the terms into two categories: *Farming* vs *Conservation*.

Hatchery, trout Unlimited (TU), raceway, astaxanthin, Steelhead habitat, Enteric redmouth disease, habitat degradation, aquaculture.

Task 9. Mark true or false.

1. Rainbow trout were first farmed in the 1950s.
2. The McCloud hatchery mixed eggs from different subspecies.
3. Idaho is the leading U.S. producer of rainbow trout.
4. Rainbow trout can hybridize with cutthroat trout.
5. Enteric redmouth disease is dangerous to humans.
6. Rainbow trout flesh is naturally pink without diet additives.
7. Steelhead are not anadromous.
8. Farmed trout are often labeled as steelhead in stores.
9. Tailwaters are unsuitable for trout farming.
10. Trout Unlimited manages hatcheries.

Task 10. Answer briefly based on the text.

1. What is a hatchery used for? 2. What is aquaculture? 3. What is a tailwater? 4. What is hybridization in trout? 5. What causes redmouth disease? 7. What is a put-and-take fishery? 8. What is habitat degradation? 9. What pigment is added to trout diets for pink flesh? 10. What is the main goal of Trout Unlimited? 11. What problem does the Beardslee trout face?

Task 11. Make up as more sentences as you can using the words and expressions from Task 2.

Task 12. Write a brief summary of the text. Read your summaries of the text to your groupmates.

Task 13. Make up a plan of this text. Retell the text according to it.

TEXT 4
INVASIVE SPECIES AND DISEASES

Task 1. Read the text and be ready to retell it.

Whirling disease

Myxobolus cerebralis is a myxosporean parasite of salmonids (salmon, trout, and their allies) that causes whirling disease in farmed salmon and trout and also in wild fish populations. It was first described in rainbow trout in Germany a century ago, but its range has spread and it has appeared in most of Europe, northern Asia, the U.S., South Africa and other countries. In the 1980s, *M. cerebralis* was found to require *Tubifex tubifex* (a kind of segmented worm) to complete its life cycle. The parasite infects its hosts with its cells after piercing them with polar filaments ejected from nematocyst-like capsules. *M. cerebralis* has been reported in Germany (1893), Italy (1954), USSR (1955), including Sakhalin Island (1960), U.S. (1958), Bulgaria (1960), Yugoslavia (1960), Sweden (1966), South Africa (1966), Scotland (1968), New Zealand (1971), Ecuador (1971), Norway (1971), Colombia (1972), Lebanon (1973), Ireland (1974), Spain (1981) and England (1981).

This parasite was originally a mild pathogen of brown trout in central Europe and other salmonids in northeast Asia, and the spread of the rainbow trout has greatly increased its impact. Having no innate immunity to *M. cerebralis*, rainbow trout are particularly susceptible, and can release so many spores that even more resistant species in the same area, such as *Salmo trutta*, can become overloaded with parasites and incur mortalities of 80 to 90 percent. Where *M. cerebralis* has become well-established, it has caused decline or even elimination of whole cohorts of fish.

The parasite *M. cerebralis* was first recorded in North America in 1956 in Pennsylvania, but until the 1990s whirling disease was considered a manageable problem only affecting rainbow trout in hatcheries. It eventually became established in natural waters of the Rocky Mountain states (Colorado, Wyoming, Utah, Montana, Idaho, New Mexico), where it is damaging several sport fishing rivers. Some streams in the western U.S. lost 90 percent of their trout. Whirling disease threatens recreational fishing, which is important for the tourism industry, a key component of the economies of some U.S. western states. For example, in 2005 anglers in Montana spent approximately $196,000,000 in activities directly related to trout fishing in the state. Some of the salmonids that *M. cerebralis* infects (bull trout, cutthroat trout, and anadromous forms of rainbow trout - steelhead) are already threatened or endangered, and the parasite could worsen their population decline.

New Zealand mud snail

Distribution of New Zealand mud snail within the U.S. in 2009

The New Zealand mud snail (*Potamopyrgus antipodarum*), once endemic to New Zealand, has spread widely and has become naturalised and an invasive species in many areas including: Australia, Tasmania, Asia (Japan), in the Garmat Ali River in Iraq since 2008), Europe (since 1859 in England), and North America (U.S. and Canada: Thunder Bay in Ontario since 2001, British Columbia since July 2007), most likely inadvertently during human activity. It can reach concentrations greater than 500,000 per m^2, endangering the food chain by outcompeting native snails and water insects for food, leading to sharp declines in native populations. There is evidence North American fishes are unable to digest the tiny but hard shells of the mud snail, and that their presence may result in poor growth outcomes for rainbow trout.

The mud snail was first detected in the U.S. in Idaho's Snake River in 1987. Since then, the snail has spread to the Madison River, Firehole River, and other watercourses around Yellowstone National Park, and has been discovered throughout the western U.S. The exact means of transmission is unknown, but it is likely that it was introduced in water transferred with live game fish and has been spread by ship ballast or contaminated recreational equipment such as wading gear.

Didymo

Didymosphenia geminata, commonly known as didymo or rock snot, is a species of diatom that produces nuisance growths in freshwater rivers and streams with consistently cold water temperatures. In New Zealand, invasive didymo can form large mats on the bottom of rivers and streams in late winter. It is not considered a significant human health risk, but it can affect stream habitats and sources of food for fish, including rainbow trout, and make recreational activities unpleasant. Even though it is native in North America, it is considered a nuisance organism or invasive species.

Redmouth disease

Enteric redmouth disease is a bacterial infection of freshwater and marine fish caused by the pathogen *Yersinia ruckeri*. It is primarily found in rainbow trout and other cultured salmonids. The disease is characterized by subcutaneous hemorrhaging of the mouth, fins, and eyes. It is most commonly seen in fish farms with poor water quality. Redmouth disease was first discovered in Idaho rainbow trout in the 1950s.

Removal methods

Some fisheries are focused on removing rainbow trout in order to reestablish native trout populations. This can be done by poisoning rivers with chemicals such as antimycin or rotenone which have been declared safe in the USA by the Environmental Protection Agency. Once the chemicals have dissipated native trout are released into the river. Another method is to use electrofishing which enable the fish to be caught alive and harvested or re-located. This technique has been used in the Great Smokey Mountains National Park to rid it of rainbow trout that were introduced in the 1930s and have thrived ever since. They are hoping to re-establish native brook trout in at least some of the 2100-mile river system. Method of control is 100% effective and are best regarded as methods to change the relative population sizes of fish species.

Steelhead declines

Steelhead (a rainbow trout of a large migratory variety) populations in parts of its native range have declined due to a variety of human and natural causes. While populations in Alaska and along the British Columbia coast are considered healthy, some populations along the U.S. west coast are in decline. The U.S. National Marine Fisheries Service has 15 identified distinct population segments (DPS)s, in Washington, Oregon, and California. Eleven of these DPSs are listed under the U.S. Endangered Species Act, ten as threatened and one as endangered. One DPS on the Oregon Coast is designated a U.S. Species of Concern.

The Southern California DPS, which was listed as endangered in 2011, has been affected by habitat loss due to dams, confinement of streams in concrete channels, water pollution, groundwater pumping, urban heat island effects, and other byproducts of urbanization.

Hatchery stocking influence

Several studies have shown that almost all California coastal steelhead are of native origin, despite over a century of hatchery stocking. Genetic analysis shows that the South Central California Coast DPS and Southern California DPS from Malibu Creek north, and including the San Gabriel River, Santa Ana River and San Mateo Creek, are not hatchery strains. Steelhead from Topanga Creek and the Sweetwater River were partly, and those from San Juan Creek completely, of hatchery origin. Genetic analysis has also shown that the steelhead in the streams of the Santa Clara County and Monterey Bay basins are not of hatchery origin, including the Coyote

Creek, Guadalupe River, Pajaro River, Permanente Creek, Stevens Creek, San Francisquito Creek, San Lorenzo River, and San Tomas Aquino Creek basins. Natural waterfalls and two major dams have isolated Russian River steelhead from freshwater rainbow trout forms above the impassable barriers; a 2007 genetic study of fin samples collected from steelhead at 20 different sites both above and below passage barriers in the watershed found that although 30 million hatchery trout were stocked in the river, the steelhead remain of native and not hatchery origin. Releases of conventionally reared hatchery steelhead pose ecological risks to wild steelhead populations. Hatchery steelhead are typically larger than the wild forms and can displace wild-form juveniles from optimal habitats. Dominance of hatchery steelhead for optimal microhabitats within streams may reduce wild steelhead survival as a result of reduced foraging opportunity and increased rates of predation.

COMPREHENSIVE CHECK

Task 2. Learn the glossary.

Adipose fin – a small fleshy appendage located behind the main dorsal fin.
Axillary process – a sharp ray extending from the fin.
Catchable – a fish that is 8–10 inches (20cm–25.4cm) long.
Caudal fin – the tail fin of a fish.
Fingerling – the stage in a fish's life between 1 inch and the length at 1 year of age.
Fry – small juvenile fish, usually smaller than 3" long.
Milt – white milky fluid containing sperm.
Kype – large hook shape on lower jaw of spawning male trout.
Parr – life stage of salmonid fish that extends from the time feeding begins until the fish become sufficiently pigmented to obliterate the parr marks, usually ending during the first year.
Parr mark – one of the vertical color bars found on young salmonids.
Pelvic fins – the paired fins corresponding to the posterior limbs of the higher vertebrates, located below or behind the pectoral fins.
Redd – area of stream or lake bottom excavated by a female trout during spawning.
Riffle – an area of shallow, rapidly flowing, choppy water in a stream.

Task 3. Provide Ukrainian equivalents for the following words and expressions, learn them, and use into your retelling.

Juveniles, silvery-white belly, fins, dark blotches, a reproductively isolated population, species, genus, family, subphylum, phylum, subfamily, order, superorder, coelacanths, lungfishes, mudflats, hot desert springs, subterranean caves, high altitude lakes and streams, polar seas, the depths of the abyss, salinities, pH levels, dissolved oxygen, to spawn, lake-dwelling and anadromous forms, lateral line, gills, breeding males, wild-caught, hatchery-reared forms, caudal fin, lifespan, alluvial or freestone streams, bedrock and spring creeks, a redd, iteroparous, genomic extinction.

Task 4. Answer the following questions using active vocabulary from the text.

1. What parasite causes whirling disease in trout?
2. What organism is required for Myxobolus cerebralis to complete its life cycle?
3. Why are rainbow trout especially vulnerable to whirling disease?
4. In what decade did whirling disease become a serious problem in U.S. natural waters?
5. What economic activity is threatened by whirling disease in the Rocky Mountain states?
6. What fish species are at risk due to M. cerebralis aside from rainbow trout?
7. Where was the New Zealand mud snail first detected in the U.S.?
8. What is one suspected method of mud snail transmission?
9. Why is the New Zealand mud snail dangerous for rainbow trout?
10. What is the common name for Didymosphenia geminata?
11. How does didymo affect stream habitats?
12. Is didymo native to North America?
13. What bacterium causes redmouth disease?
14. Where was redmouth disease first discovered?
15. What is one characteristic symptom of redmouth disease?
16. What chemicals are used to remove invasive trout populations?
17. What method is used in the Great Smoky Mountains to remove rainbow trout?
18. What is the main goal of removing rainbow trout from certain rivers?
19. How many steelhead DPS (distinct population segments) are listed under the U.S. Endangered Species Act?
20. How can hatchery steelhead negatively affect wild populations?

Task 5. Write the definitions from the text.

1. Whirling disease
2. Tubifex tubifex
3. Didymo
4. New Zealand mud snail
5. Redmouth disease
6. Electrofishing
7. Antimycin
8. DPS (Distinct Population Segment)
9. Over-harvest
10. Hatchery stocking

Task 6. Fill in the blank.

1. *Whirling disease* is caused by the parasite ____.
2. The parasite needs ____ to complete its life cycle.
3. ____ are especially vulnerable to whirling disease.
4. ____ was first found in the U.S. in 1987.
5. ____ is also known as "rock snot".
6. ____ causes redmouth disease.
7. ____ allows live fish to be captured and relocated.
8. The U.S. has ____ steelhead DPSs identified by NOAA.
9. ____ and ____ are used to kill invasive fish.
10. ____ can dominate and displace wild steelhead.

Task 7. Choose the right variant.

1. What is required for *M. cerebralis* to complete its life cycle?
   a) Algae
   b) Snail
   c) Worm
   d) Fungus
2. What disease causes fish to spin in circles?
   a) Redmouth
   b) Ich
   c) Fin rot
   d) Whirling disease

3. What is a major concern with mud snails?
   a) They carry human diseases
   b) They are large predators
   c) They outcompete native snails
   d) They filter too much water
4. What is Didymo commonly called?
   a) River moss
   b) Rock snot
   c) Green slime
   d) Water mold
5. Where was redmouth disease first reported?
   a) Colorado
   b) Idaho
   c) Montana
   d) Alaska
6. What technique allows removal of live fish without killing them?
   a) Netting
   b) Poisoning
   c) Electrofishing
   d) Harpooning
7. What type of fish is a steelhead?
   a) Coldwater minnow
   b) Anadromous rainbow trout
   c) Hybrid of salmon and trout
   d) Native mud snail predator
8. What is a risk of hatchery steelhead?
   a) Higher mortality
   b) Lower oxygen needs
   c) They can displace wild juveniles
   d) Faster swimming
9. How do mud snails spread?
   a) Air
   b) Bird droppings
   c) Contaminated gear
   d) Reproduction in rocks
10. Which region has healthy steelhead populations?
   a) Southern California
   b) British Columbia coast
   c) Oregon

d) Kamchatka

Task 8. Match each term on the left with its definition on the right.

Term	Description
1. Antimycin	A. Parasite-based illness in trout
2. Over-harvest	B. Worm host for parasite
3. DPS	C. Nuisance algae in cold streams
4. Redmouth disease	D. Bacterial illness in trout
5. Mud snail	E. Method of fish removal using electricity
6. Didymo	F. Chemical used to remove unwanted fish
7. Hatchery steelhead	G. Farm-raised steelhead
8. Tubifex tubifex	H. Taking too many fish from the wild
9. Whirling disease	I. A population segment under conservation law
10. Electrofishing	J. Invasive snail affecting food chains

Task 9. Identify the category: 1. Diseases & Parasites and 2. Invasive Species & Control.

Whirling disease, Didymo, Electrofishing, Yersinia ruckeri, Antimycin, Redmouth disease, Hatchery removal, Myxobolus cerebralis, New Zealand mud snail, Tubifex tubifex.

Task 10. Mark true or false.

1. Myxobolus cerebralis causes whirling disease.
2. Didymo is a type of fish parasite.
3. Redmouth disease was first found in Idaho.
4. Mud snails are native to North America.
5. Electrofishing kills all fish in the water.
6. The Southern California steelhead DPS is endangered.
7. Antimycin is approved by the EPA for fish removal.
8. Hatchery steelhead help wild steelhead survival.
9. Didymo affects fish health and food sources.
10. Rainbow trout are resistant to whirling disease.

Task 11. Answer the questions using the vocabulary context.

1. What causes whirling disease?
2. What does the New Zealand mud snail do to native species?
3. Where is redmouth disease most common?

4. What is electrofishing used for?
5. Why are hatchery steelhead a problem for wild ones?
6. What kind of organism is didymo?
7. What is the purpose of antimycin?
8. What makes rainbow trout vulnerable?

Task 12. Make up as more sentences as you can using the words and expressions from Task 3.

Task 13. Write a brief summary of the text. Read your summaries of the text to your groupmates.

Task 14. Make up a plan of this text. Retell the text according to it.

Task 15. Read the text and write a short summary of the text.

RAINBOW TROUT NATURAL HISTORY

Rainbow trout (Oncorhynchus mykiss) have very small, fine scales on their torpedo-shaped body. They have silvery sides with a horizontal pinkish band that varies in intensity in different populations. The back is bluish to greenish with black spots on the back and sides. Rainbows have no teeth on the tongue.

Rainbow trout belong to the family of fish known as salmon and are characterized by adipose fins and by an axillary process at the base of each pelvic fin. The caudal fin is not forked, and has radiating rows of black spots. There are more than a hundred varieties of rainbow trout, but only three subspecies: the common rainbow; steelhead (or coastal rainbow); and Kamloops rainbow. Rainbows may live up to 11 years, but the usual life span is four to six years. Growth is highly variable, depending on the habitat. A typical stream-dwelling rainbow grows to weigh about 1 pound (0.5 kg) in four years. Rainbow trout are native only to the Pacific slope of North America, but have been widely introduced on every continent, except Antarctica.

Rainbow trout prefer cool, clear streams and lakes, but can survive in lakes or ponds on the rairie, as long as there is cool, oxygenated water in the depths. Rainbows prefer water from 55 to 60 F, and will tolerate temperatures up to 75 F. Rainbow trout are stocked in Black Hills area lakes and are also found in a few streams. Fingerling rainbows are stocked in some spring fed ponds on the prairie. Most South Dakota lakes and streams do not presently have suitable conditions for natural reproduction of rainbows. Thus, SD Game, Fish and Parks stock hatchery-raised fish to provide the trout fishery.

The diet consists mainly of immature and adult insects, plankton, crustaceans, fish eggs, and small fishes. Rainbows consume far fewer fish than do brown trout.

In the wild, most varieties of rainbows spawn in spring, however, spawning may occur anytime of the year. Spawning takes place in small tributaries, often at the inlet or outlet of a lake, where water temperatures reach 50 to 60 F (10-16 C). The spawning site is usually the tail of a pool, or the riffle at the head of a pool, where gravel bars have ample oxygen-rich water, and no suffocating silt. Before spawning, males undergo astounding anatomical changes. A male's jaws lengthen and the lower jaw develops a kype. All fish become darker when in spawning condition. Their spots become more prominent and the pink stripe more intense.

The female digs several redds for depositing the eggs. She turns on her side and beats her tail against the bottom, moving the gravel away to create a depression longer than her body and about half as deep. As the female digs, she is often accompanied by more than one male. The largest male is dominant and defends his territory by charging the smaller ones, using his kype to nip them. The male and female lie side by side and release milt and eggs. Sometimes the other males also deposit milt in the redd.

As spawning proceeds, successive groups of fertilized eggs are covered by gravel washed from the upstream edge of the redd by the females vigorous digging. The completed redd consists of many layers of eggs and clean gravel. When all the spawning activity is complete, the parents abandon the redd. Trout eggs range from 0.08 to 0.2 inches in diameter (2-5mm), and a 10-pound (4.5 kg) rainbow deposits about 4,000 eggs. A walleye of the same size deposits about 200,000. Eggs incubate from one to five months depending on trout subspecies and water temperature. This long incubation period subjects the eggs to many hazards, such as disease, drought and flooding. Eggs that are not well-buried are quickly eaten by predators such as crayfish, insects and fish, including trout.

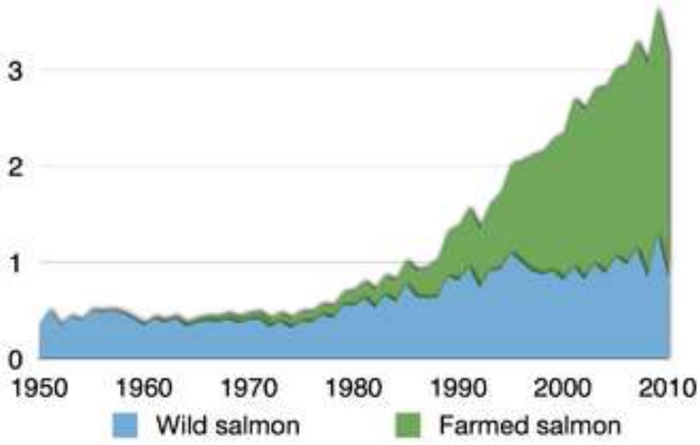
The eggs hatch in the gravel, and at first the sac-fry, 3/4" to 1" (20-25mm) long can move very little. They do not feed, but absorb nutrients from the attached yolk sac. After several weeks, they wiggle through the gravel and emerge into the stream. After the fry absorb the yolk sac, they begin feeding on plankton. As the fish grow, they develop parr marks on their sides. At this stage, the fish are called parr. Rainbow trout lose their parr marks as they mature. Predation is severe during a trout's early life. Kingfishers, herons, and other fishes take the greatest toll. Usually fewer than one percent of the newly hatched fry survive their first year.

UNIT 4
SALMON

TEXT 1
SALMON

Task 1. Read the text and be ready to retell it.

Pacific salmon leaping at Willamette Falls, Oregon



Commercial production of salmon in million tonnes 1950–2010

Salmon /ˈsæmən/ is the common name for several species of ray-finned fish in the family Salmonidae. Other fish in the same family include trout, char, grayling and whitefish. Salmon are native to tributaries of the North Atlantic (genus *Salmo*) and Pacific Ocean (genus *Oncorhynchus*). Many species of salmon have been introduced into non-native environments such as the Great Lakes of North America and Patagonia in South America. Salmon are intensively farmed in many parts of the world. Typically, salmon are anadromous: they are born in fresh water, migrate to the ocean, then return to fresh water to reproduce. However, populations of several species are restricted to fresh water through their lives. Various species of salmon display anadromous life strategies while others display freshwater resident life strategies. Folklore has it that the fish return to the exact spot where they were born to spawn; tracking studies have shown this to be mostly true. A portion of a returning salmon run may stray and spawn in different freshwater systems. The percent of straying depends on the species of salmon. Homing behavior has been shown to depend on olfactory memory.

Species

The term "salmon" comes from the Latin *salmo*, which in turn may have originated from *salire*, meaning "to leap". The nine commercially important species of salmon occur in two genera. The genus *Salmo* contains the Atlantic salmon, found in the north Atlantic, as well as many species commonly named trout. The genus *Oncorhynchus* contains eight species which occur naturally only in the North Pacific. As a group, these are known as Pacific salmon. Chinook salmon have been introduced in New Zealand and Patagonia. Coho, freshwater sockeye, and Atlantic salmon have been established in Patagonia, as well.

This article is one of a series on
Commercial fish

Large pelagic
billfish, bonito mackerel, salmon shark, tuna
Forage
anchovy, herring menhaden, sardine shad, sprat
Demersal
cod, eel, flatfish pollock, ray
Mixed
carp, tilapia

Atlantic and Pacific salmon

Genus	Common name	Scientific name	Maximum length	Common length	Maximum weight	Maximum age	Trophic level	Fish Base	AO	TIS	UCN status
Salmo **(Atlantic salmon)**	Atlantic salmon	*Salmo salar* Linnaeus, 1758	150 cm	120 cm	46.8 kg	13 years	.4	7]	8]	9]	Least concern
Oncorhynchus **(Pacific salmon)**	Chinook salmon	*Oncorhynchus tshawytscha* (Walbaum, 1792)	150 cm	70 cm	61.4 kg	9 years	.4	11]	12]	13]	Not assessed
	Chum salmon	*Oncorhynchus keta* (Walbaum, 1792)	100 cm	58 cm	15.9 kg	7 years	.5	14]	15]	16]	Not assessed
	Coho salmon	*Oncorhynchus kisutch* (Walbaum, 1792)	108 cm	71 cm	15.2 kg	5 years	.2	17]	18]	19]	Not assessed
	Masu salmon	*Oncorhynchus masou* (Brevoort, 1856)	79 cm	cm	10.0 kg	3 years	.6	20]		21]	Not assessed
	Pink salmon	*Oncorhynchus gorbuscha* (Walbaum, 1792)	76 cm	50 cm	6.8 kg	3 years	.2	22]	23]	24]	Not assessed
	Sockeye salmon	*Oncorhynchus nerka* (Walbaum, 1792)	84 cm	58 cm	7.7 kg	8 years	.7	25]	26]	27]	Least concern

† Both the *Salmo* and *Oncorhynchus* genera also contain a number of species referred to as trout. Within *Salmo*, additional minor taxa have been called salmon in English, i.e. the Adriatic salmon (*Salmo obtusirostris*) and Black Sea salmon (*Salmo labrax*). The steelhead anadromous form of the rainbow trout migrates to sea, but it is not termed "salmon".

Also a number of other species have common names which refer to them as being salmon. Of those listed below, the Danube salmon or *huchen* is a large freshwater salmonid related to the salmon above, but others are marine fishes of the unrelated Perciformes order:

Some other fishes called salmon

Common name	**Scientific name**	**Maximum length**	**Common length**	**Maximum weight**	**Maximum age**	**Trophic level**	**FishBase**	**AO**	**TIS**	**IUCN status**
Australian salmon	*Arripis trutta* (Forster, 1801)	89 cm	47 cm	9.4 kg	26 years	4.1	29]		30]	Not assessed
Danube salmon	*Hucho hucho* (Linnaeus, 1758)	150 cm	70 cm	52 kg	15 years	4.2	31]		32]	Endanger
Hawaiian salmon	*Elagatis bipinnulata* (Quoy & Gaimard, 1825)	180 cm	90 cm	46.2 kg	years	3.6	34]	35]	36]	Not assessed
Indian salmon	*Eleutheronema tetradactylum* (Shaw, 1804)	200 cm	50 cm	145 kg	years	4.4	37]		38]	Not assessed

Eosalmo driftwoodensis, the oldest known salmon in the fossil record, helps scientists figure how the different species of salmon diverged from a common ancestor. The British Columbia salmon fossil provides evidence that the divergence between Pacific and Atlantic salmon had not yet occurred 40 million years ago. Both the fossil record and analysis of mitochondrial DNA suggest the divergence occurred by 10 to 20 million years ago. This independent evidence from DNA analysis and the fossil record rejects the glacial theory of salmon divergence.

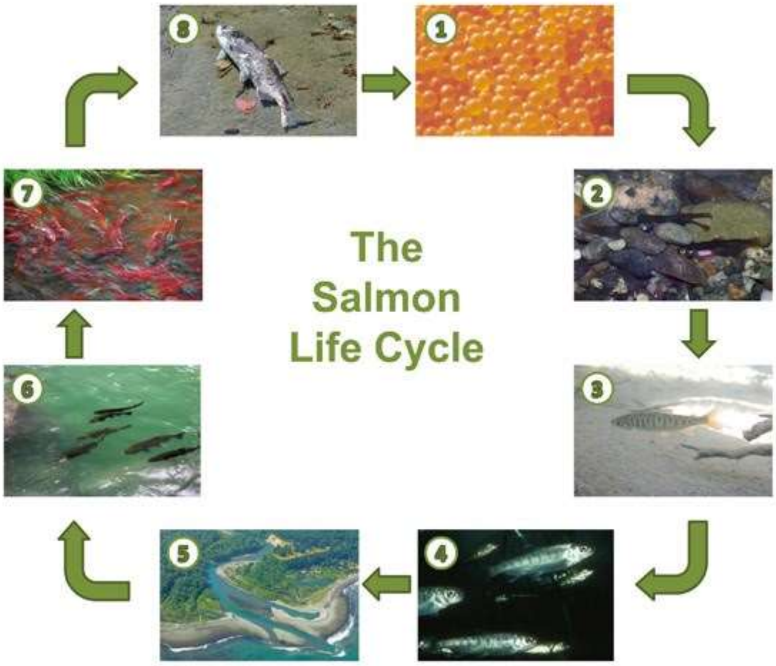
Distribution

Atlantic salmon, *Salmo salar*

- Atlantic salmon (*Salmo salar*) reproduce in northern rivers on both coasts of the Atlantic Ocean.
- Landlocked salmon (*Salmo salar* m. *sebago*) live in a number of lakes in eastern North America and in Northern Europe, for instance in lakes Sebago, Onega, Ladoga, Saimaa, Vänern, and Winnipesaukee. They are not a different species from the Atlantic salmon, but have independently evolved a non-migratory life cycle, which they maintain even when they could access the ocean.

- Chinook salmon (*Oncorhynchus tshawytscha*) are also known in the US as king salmon or blackmouth salmon, and as spring salmon in British Columbia. Chinook are the largest of all Pacific salmon, frequently exceeding 14 kg (30 lb). The name tyee is used in British Columbia to refer to Chinook over 30 pounds, and in the Columbia River watershed, especially large Chinook were once referred to as June hogs. Chinook salmon are known to range as far north as the Mackenzie River and Kugluktuk in the central Canadian arctic, and as far south as the Central California coast.
- Chum salmon (*Oncorhynchus keta*) are known as dog, keta, or calico salmon in some parts of the US. This species has the widest geographic range of the Pacific species: south to the Sacramento River in California in the eastern Pacific and the island of Kyūshū in the Sea of Japan in the western Pacific; north to the Mackenzie River in Canada in the east and to the Lena River in Siberia in the west.
- Coho salmon (*Oncorhynchus kisutch*) are also known in the US as silver salmon. This species is found throughout the coastal waters of Alaska and British Columbia and as far south as Central California (Monterey Bay). It is also now known to occur, albeit infrequently, in the Mackenzie River.
- Masu salmon or cherry salmon (*Oncorhynchus masou*) are found only in the western Pacific Ocean in Japan, Korea, and Russia. A land-locked subspecies known as the Taiwanese salmon or Formosan salmon (*Oncorhynchus masou formosanus*) is found in central Taiwan's Chi Chia Wan Stream.
- Pink salmon (*Oncorhynchus gorbuscha*), known as humpies in southeast and southwest Alaska, are found from northern California and Korea, throughout the northern Pacific, and from the Mackenzie River in Canada to the Lena River in Siberia, usually in shorter coastal streams. It is the smallest of the Pacific species, with an average weight of 1.6 to 1.8 kg (3.5 to 4.0 lb).
- Sockeye salmon (*Oncorhynchus nerka*) are also known in the US as red salmon.[47] This lake-rearing species is found south as far as the Klamath River in California in the eastern Pacific and northern Hokkaidō island in Japan in the western Pacific and as far north as Bathurst Inlet in the Canadian Arctic in the east and the Anadyr River in Siberia in the west. Although most adult Pacific salmon feed on small fish, shrimp, and squid, sockeye feed on plankton they filter through gill rakers. Kokanee salmon are the land-locked form of sockeye salmon.
- Danube salmon, or huchen (*Hucho hucho*), are the largest permanent freshwater salmonid species.

Life cycle



1. Salmon eggs, 2. Alevins, 3. Coho fry, 4. Smolts, 5. The Elwha River draining into the Strait of Juan de Fuca, 6. Coho migrating to spawn, 7. Sockeye spawning, 8. Dead salmon after spawning

Eggs in different stages of development: In some, only a few cells grow on top of the yolk, in the lower right, the blood vessels surround the yolk, and in the upper left, the black eyes are visible, even the little lens.

Salmon fry hatching - the baby has grown around the remains of the yolk - visible are the arteries spinning around the yolk and little old drops, also the gut, the spine, the main caudal blood vessel, the bladder, and the arcs of the gills. Salmon eggs are laid in freshwater streams typically at high latitudes. The eggs hatch into alevin or sac fry. The fry quickly develop into parr with camouflaging vertical stripes. The parr stay for six months to three years in their natal stream before becoming smolts, which are distinguished by their bright, silvery colour with scales that are easily rubbed off. Only 10% of all salmon eggs are estimated to survive to this stage. The smolt body chemistry changes, allowing them to live in salt water. Smolts spend a portion of their out-migration time in brackish water, where their body chemistry becomes accustomed to osmoregulation in the ocean.

Juvenile salmon, parr, grow up in the relatively protected natal river

The parr lose their camouflage bars and become smolt as they become ready for the transition to the ocean.

Male ocean-phase adult sockeye

Male spawning-phase adult sockeye

The salmon spend about one to five years (depending on the species) in the open ocean, where they gradually become sexually mature. The adult salmon then return primarily to their natal streams to spawn. Atlantic salmon spend between one and four years at sea. (When a fish returns after just one year's sea feeding, it is called a grilse in Canada, Britain, and Ireland.) Prior to spawning, depending on the species, salmon undergo changes. They may grow a hump, develop canine-like teeth, or develop a kype (a pronounced curvature of the jaws in male salmon). All change from the silvery blue of a fresh-run fish from the sea to a darker colour. Salmon can make amazing journeys, sometimes moving hundreds of miles upstream against strong currents and rapids to reproduce. Chinook and sockeye salmon from central Idaho, for example, travel over 1,400 km (900 mi) and climb nearly 2,100 m (7,000 ft) from the Pacific Ocean as they return to spawn. Condition tends to deteriorate the longer the fish remain in fresh water, and they then deteriorate further after they spawn, when they are known as kelts. In all species of Pacific salmon, the mature individuals die within a few days or weeks of spawning, a trait known as semelparity. Between 2 and 4% of Atlantic salmon kelts survive to spawn again, all females. However, even in those species of salmon that may survive to spawn more than once (iteroparity), postspawning mortality is quite high (perhaps as high as 40 to 50%).

To lay her roe, the female salmon uses her tail (caudal fin), to create a low-pressure zone, lifting gravel to be swept downstream, excavating a shallow depression, called a redd. A redd may sometimes contain 5,000 eggs covering 2.8 m^2 (30 sq ft). The eggs usually range from orange to red. One or more males approach the female in her redd, depositing sperm, or milt, over the roe. The female then covers the eggs by disturbing the gravel at the upstream edge of the depression before moving on to make another redd. The female may make as many as seven redds before her supply of eggs is exhausted.

Each year, the fish experiences a period of rapid growth, often in summer, and one of slower growth, normally in winter. It results in ring formation around an earbone called the otolith, (annuli) analogous to the growth rings visible in a tree trunk. Freshwater growth shows as densely crowded rings, sea growth as widely spaced rings; spawning is marked by significant erosion as body mass is converted into eggs and milt.

Freshwater streams and estuaries provide important habitat for many salmon species. They feed on terrestrial and aquatic insects, amphipods, and other crustaceans while young, and primarily on other fish when older. Eggs are laid in deeper water with larger gravel, and need cool water and good water flow (to supply oxygen) to the developing embryos. Mortality of salmon in the early life stages is usually high due to natural predation and human-induced changes in habitat, such as siltation, high water temperatures, low oxygen concentration, loss of stream cover, and reductions in river flow. Estuaries and their associated wetlands provide vital nursery areas for the salmon prior to their departure to the open ocean. Wetlands not only help buffer the estuary from silt and pollutants, but also provide important feeding and hiding areas.

Salmon not killed by other means show greatly accelerated deterioration (phenoptosis, or "programmed aging") at the end of their lives. Their bodies rapidly deteriorate right after they spawn as a result of the release of massive amounts of corticosteroids.

COMPREHENSIVE CHECK

Task 2. Provide Ukrainian equivalents for the following words and expressions, learn them, and use into your retelling.

Ray-finned fish, grayling, tributaries, diverged, glacial, albeit, humpies, an average weight, lake-rearing species, squid, sockeye, yolk, cells, the gut, the spine, the main caudal blood vessel, the bladder, and the arcs of the gills, little lens, alevin, sac fry, camouflaging vertical stripes, to deteriorate,

Task 3. Answer the following questions using active vocabulary from the text.

1. What family of fish does salmon belong to?
2. What other fish are included in the Salmonidae family?
3. What type of water do salmon typically spawn in?
4. What does it mean that salmon are anadromous?
5. Where are salmon originally native to?
6. What allows salmon to return to their birthplace to spawn?
7. How many genera of commercially important salmon exist?
8. What genus contains the Atlantic salmon?
9. How many Pacific salmon species are there?
10. What is the largest species of Pacific salmon?

11. What is the landlocked form of Atlantic salmon called?
12. What is the smallest Pacific salmon species?
13. What do sockeye salmon feed on in the ocean?
14. What is a redd in salmon reproduction?
15. What happens to Pacific salmon after they spawn?
16. What is a kype, and when does it appear in salmon?
17. What body part do scientists study to determine salmon age?
18. Why are estuaries important to salmon?
19. What percent of Atlantic salmon kelts may survive to spawn again?
20. What are some causes of high mortality in early salmon life stages?

Task 4. Fill in the blanks.

1. Salmon eggs hatch into tiny fish called ______.
2. A ______ is a juvenile salmon with camouflage stripes.
3. A ______ is a curved jaw seen in male spawning salmon.
4. The salmon returns to its birth stream through ______ behavior.
5. After hatching, salmon develop in the ______ before reaching the ocean.
6. Salmon create a ______ to lay their eggs in.
7. A ______ is the sperm released by male salmon.
8. When salmon migrate to the ocean, they become a ______.
9. The ______ is where rivers meet the sea.
10. Scientists analyze the ______ to age a salmon.

Task 5. Match each term on the left with its definition on the right.

Terms	Definitions
1. Parr	A. Sperm of male salmon
2. Kype	B. Bone in fish used to determine age (like tree rings)
3. Milt	C. A newly hatched salmon still attached to the yolk sac
4. Estuary	D. Area where freshwater meets saltwater, important for smolt transition
5. Otolith	E. A juvenile salmon with vertical stripes for camouflage
6. Alevin	F. The salmon's instinct to return to its birthplace to spawn
7. Homing	G. A nest-like depression where female salmon lay their eggs
8. Reed	H. Fish that migrate from freshwater to saltwater and back to spawn

Task 6. Choose the correct word.

1. A salmon that lives only in freshwater is called (landlocked / oceanic).
2. Salmon feed on plankton using their (gills / fins).
3. A Chinook over 30 pounds is called a (tyee / parr).
4. The process of aging salmon rapidly after spawning is called (phenoptosis / migration).
5. Only (2% / 50%) of Atlantic kelts may spawn again.
6. Pacific salmon species usually die after (feeding / spawning).
7. A _____ is a female salmon's egg-laying depression. (redd / gill)
8. _____ behavior helps salmon find their natal stream. (Homing / Hatching)
9. Landlocked Atlantic salmon evolved a _____ life cycle. (non-migratory / deep sea)
10. A ____ is a young salmon ready for saltwater. (smolt / alevin)

Task 7. Match the species to their region or characteristic.

Species	Region or Characteristic
1. Kokanee salmon	A. Plankton feeder, red during spawning
2. Coho salmon	B. Largest Pacific salmon, also called king salmon
3. Masu salmon	C. Smallest Pacific salmon, known as "humpies"
4. Danube salmon	D. Known as silver salmon
5. Landlocked	E. Widest range of Pacific salmon
6. Pink salmon	F. Found only in western Pacific (Japan, Korea)
7. Sockeye salmon	G. Native to North Atlantic
8. Chum salmon	H. Non-migratory form of Atlantic salmon in inland lakes
9. Atlantic salmon	I. Landlocked form of sockeye salmon
10. Chinook salmon	J. Largest permanent freshwater salmonid

Task 8. Label the salmon life cycle steps (1 to 5).

Put in order:

- Alevin
- Adult spawning salmon
- Smolt
- Parr
- Egg

Task 9. Mark true or false.

1. Alevin is another word for adult salmon.
2. Smolts are silvery and ready for saltwater.
3. A redd is made by the male salmon.
4. Otoliths are used to study fish age.
5. The term “salmon” comes from a Latin word meaning “to swim.”
6. A kype is a feature found on female salmon.
7. Estuaries help salmon adjust to saltwater.
8. Parr are found in the ocean.
9. Milt is the salmon’s reproductive fluid.
10. Phenoptosis means accelerated death after spawning.

Task 10. Choose the correct answer.

1. Which genus includes Pacific salmon?
   a) Salmo
   b) Oncorhynchus
   c) Hucho
   d) Arripis
2. What helps salmon navigate back to their birthplace?
   a) Sight
   b) Olfactory memory
   c) Temperature
   d) Ocean currents
3. Which is a freshwater-only species of salmon?
   a) Chinook
   b) Pink
   c) Kokanee
   d) Coho
4. What do juvenile salmon primarily feed on?
   a) Plankton
   b) Fish
   c) Insects and crustaceans
   d) Algae
5. How many eggs might a female salmon lay in one redd?
   a) 500
   b) 2,000

c) 5,000
d) 10,000

6. What term describes a salmon that returns after one year at sea?
   a) Kelt
   b) Grilse
   c) Smolt
   d) Fry
7. What does "anadromous" refer to?
   a) Saltwater breeding
   b) Freshwater migration
   c) Ocean feeding and freshwater spawning
   d) All-year ocean dwelling
8. What kind of change marks a spawning salmon?
   a) Silver scales
   b) Shorter fins
   c) Hump and teeth development
   d) Reduced jaw curve
9. What is the life span of pink salmon?
   a) 2 years
   b) 4 years
   c) 6 years
   d) 10 years
10. Which of the following is not a real salmonid?
   a) Coho
   b) Masu
   c) Danube
   d) Australian

Task 11. Make up as more sentences as you can using the words and expressions from Task 2.

Task 12. Write a brief summary of the text. Read your summaries of the text to your groupmates.

Task 13. Make up a plan of this text. Retell the text according to it.

TEXT 2
ECOLOGY

Task 1. Read the text and be ready to retell it.

Bear cub with salmon

Bears and salmon

In the Pacific Northwest and Alaska, salmon are keystone species, supporting wildlife such as birds, bears and otters. The bodies of salmon represent a transfer of nutrients from the ocean, rich in nitrogen, sulfur, carbon and phosphorus, to the forest ecosystem.

Grizzly bears function as ecosystem engineers, capturing salmon and carrying them into adjacent wooded areas. There they deposit nutrient-rich urine and feces and partially eaten carcasses. Bears are estimated to leave up to half the salmon they harvest on the forest floor, in densities that can reach 4,000 kilograms per hectare, providing as much as 24% of the total nitrogen available to the riparian woodlands. The foliage of spruce trees up to 500 m (1,600 ft) from a stream where grizzlies fish salmon have been found to contain nitrogen originating from fished salmon.

Beavers and salmon

Beavers also function as ecosystem engineers; in the process of clear-cutting and damming, beavers alter their ecosystems extensively. Beaver ponds can provide critical habitat for juvenile salmon. An example of this was seen in the years following 1818 in the Columbia River Basin. In 1818, the British government made an agreement with the U.S. government to allow U.S. citizens access to the Columbia catchment (see Treaty of 1818). At the time, the Hudson's Bay Company sent word to trappers to extirpate all furbearers from the area in an effort to make the area less attractive to U.S. fur traders. In response to the elimination of beavers from large parts of the river system, salmon runs plummeted, even in the absence of many of the factors usually associated with the demise of salmon runs. Salmon recruitment can be affected by beavers' dams because dams can:

- Slow the rate at which nutrients are flushed from the system; nutrients provided by adult salmon dying throughout the fall and winter remain available in the spring to newly hatched juveniles
- Provide deeper water pools where young salmon can avoid avian predators
- Increase productivity through photosynthesis and by enhancing the conversion efficiency of the cellulose-powered detritus cycle
- Create low-energy environments where juvenile salmon put the food they ingest into growth rather than into fighting currents
- Increase structural complexity with many physical niches where salmon can avoid predators

Beavers' dams are able to nurture salmon juveniles in estuarine tidal marshes where the salinity is less than 10 ppm. Beavers build small dams of generally less than 60 cm (2 ft) high in channels in the myrtle zone. These dams can be overtopped at high tide and hold water at low tide. This provides refuges for juvenile salmon so they do not have to swim into large channels where they are subject to predation.

Lampreys and salmon

It has been discovered that rivers which have seen a decline or disappearance of anadromous lampreys also affects the salmon in a negative way. Like salmon, the adults stop feeding and die after spawning, and their decomposing bodies release nutrients into the stream. Their larvae, called ammocoetes, are filter feeders that contributes to the health of the waters. They are a food source for the young salmon, and being fattier and oilier, it is assumed predators prefer them over salmon offspring, taking off some of the predation pressure on smolts.

Parasites

According to Canadian biologist Dorothy Kieser, the myxozoan parasite *Henneguya salminicola* is commonly found in the flesh of salmonids. It has been recorded in the field samples of salmon returning to the Haida Gwaii Islands. The fish responds by walling off the parasitic infection into a number of cysts that contain milky fluid. This fluid is an accumulation of a large number of parasites.

Henneguya salminicola, a myxozoan parasite commonly found in the flesh of salmonids on the West Coast of Canada, in coho salmon

Henneguya and other parasites in the myxosporean group have complex life cycles, where the salmon is one of two hosts. The fish releases the spores after spawning. In the *Henneguya* case, the spores enter a second host, most likely an invertebrate, in the spawning stream. When juvenile salmon migrate to the Pacific Ocean, the second host releases a stage infective to salmon. The parasite is then carried in the salmon until the next spawning cycle. The myxosporean parasite that causes whirling disease in trout has a similar life cycle. However, as opposed to whirling disease, the *Henneguya* infestation does not appear to cause disease in the host salmon — even heavily infected fish tend to return to spawn successfully.

According to Dr. Kieser, a lot of work on *Henneguya salminicola* was done by scientists at the Pacific Biological Station in Nanaimo in the mid-1980s, in particular, an overview report which states, "the fish that have the longest fresh water residence time as juveniles have the most noticeable infections. Hence in order of prevalence coho are most infected followed by sockeye, chinook, chum and pink." As well, the report says, at the time the studies were conducted, stocks from the middle and upper reaches of large river systems in British Columbia such as Fraser, Skeena, Nass and from mainland coastal streams in the southern half of B.C., "are more likely to have a low prevalence of infection." The report also states, "It should be stressed that *Henneguya*, economically deleterious though it is, is harmless from the view of public health. It is strictly a fish parasite that cannot live in or affect warm blooded animals, including man".

According to Klaus Schallie, Molluscan Shellfish Program Specialist with the Canadian Food Inspection Agency, "*Henneguya salminicola* is found in southern B.C. also and in all species of salmon. I have previously examined smoked chum salmon sides that were riddled with cysts and some sockeye runs in Barkley Sound (southern B.C., west coast of Vancouver Island) are noted for their high incidence of infestation."

Sea lice, particularly *Lepeophtheirus salmonis* and various *Caligus* species, including *C. clemensi* and *C. rogercresseyi*, can cause deadly infestations of both farm-grown and wild salmon. Sea lice are ectoparasites which feed on mucus, blood, and skin, and migrate and latch onto the skin of wild salmon during free-swimming, planktonic nauplii and copepodid larval stages, which can persist for several days. Large numbers of highly populated, open-net salmon farms can create exceptionally large concentrations of sea lice; when exposed in river estuaries containing large numbers of open-net farms, many young wild salmon are infected, and do not survive as a result. Adult salmon may survive otherwise critical numbers of sea lice, but small, thin-skinned juvenile salmon migrating to sea are highly vulnerable. On the Pacific coast of Canada, the louse-induced mortality of pink salmon in some regions is commonly over 80%.

COMPREHENSIVE CHECK

Task 2. Provide Ukrainian equivalents for the following words and expressions, learn them, and use into your retelling.

Supporting wildlife, adjacent, nutrient-rich urine and feces and partially eaten carcasses, estimate, riparian woodlands, the foliage of spruce trees, make an agreement, salmon recruitment, newly hatched juveniles, avian predators, enhancing the conversion efficiency, structural complexity, physical niches, estuarine tidal marshes, the myrtle zone, overtopped, anadromous lampreys, in a negative way, being fattier and oilier, milky fluid, heavily infected fish, the longest fresh water residence time, a low prevalence of infection, sea lice, deadly infestations, free-swimming, planktonic nauplii and copepodid larval stages, open-net farms.

Task 3. Answer the following questions using active vocabulary from the text.

1. What role do salmon play in the ecosystems of the Pacific Northwest and Alaska?
2. How do grizzly bears contribute to nutrient cycling in forest ecosystems?

3. What percentage of nitrogen in riparian woodlands is estimated to come from salmon deposited by bears?
4. How far from a stream can nitrogen from salmon be detected in spruce tree foliage?
5. What impact did the elimination of beavers have on salmon populations in the Columbia River Basin?
6. List two ways beaver dams benefit juvenile salmon.
7. What is the significance of beaver ponds in estuarine tidal marshes for juvenile salmon?
8. How do lampreys contribute to the health of salmon populations?
9. What is the primary diet of juvenile salmon?
10. Describe the life cycle of the parasite Henneguya salminicola.
11. Which salmon species are most commonly affected by Henneguya salminicola?
12. What is the appearance of Henneguya salminicola cysts in infected salmon?
13. Do Henneguya salminicola infections harm salmon health?
14. What is the primary host for Henneguya salminicola?
15. How do sea lice infestations affect juvenile salmon?
16. What is the primary diet of sea lice?
17. How do sea lice infestations impact salmon farming?
18. What is the significance of the Columbia River Basin for salmon populations?
19. How do federal dams impact Native American tribes in the Pacific Northwest?
20. What measures are being taken to restore wild salmon populations in the Pacific Northwest?

Task 4. Choose the right variant.

1. Keystone species –
   a) Вид, що живе в ключових місцях
   b) Вид, що не має хижаків
   c) Вид, що суттєво впливає на екосистему
   d) Вид, занесений до Червоної книги
2. Riparian woodlands –
   a) Ліс поблизу гір
   b) Прибережний ліс
   c) Пустельна територія
   d) Затоплювана територія
3. Carcass –
   a) Живе тіло
   b) Залишки тварини

c) Місце схованки
d) Гніздо

4. Estuarine tidal marshes –
a) Скеляста берегова зона
b) Прісноводна річка
c) Приливно-відпливні болотисті місця
d) Засушлива місцевість
5. Juvenile –
a) Доросла тварина
b) Молодь/молодняк
c) Старе дерево
d) Вид рослини
6. Filter feeders –
a) Ті, хто споживає лише рослини
b) Хижаки
c) Організми, що фільтрують їжу з води
d) Залишкові організми
7. Infestation –
a) Зменшення кількості
b) Масове зараження
c) Сприятливі умови
d) Повільне розмноження
8. Productivity –
a) Виробництво
b) Енергія
c) Продуктивність/біологічна родючість
d) Забруднення
9. Habitat –
a) Середовище існування
b) Вид тварини
c) Тип захворювання
d) Поживна речовина
10. Extirpate –
a) Поширювати
b) Виключати
c) Знищити повністю
d) Вивчати

Task 5. Fill in the blanks with the words from the text.

1. Salmon are considered _____ species in the Pacific Northwest.
2. Grizzly bears act as ecosystem _____.
3. The forest gets nutrients from bear _____ and partially eaten salmon.
4. Beaver ponds provide critical _____ for young salmon.
5. The Treaty of 1818 led to the _____ of beavers in some areas.
6. Decomposing lampreys release _____ into the stream.
7. Sea lice can cause deadly _____ in salmon.
8. Henneguya salminicola is a _____ found in salmon flesh.
9. Juvenile salmon benefit from the _____ water created by beaver dams.
10. Spruce foliage far from streams contains _____ from salmon.

Task 6. Translate the terms into Ukrainian.

1. Keystone species
2. Ecosystem engineers
3. Nutrient-rich
4. Habitat
5. Recruitment
6. Detritus cycle
7. Avian predators
8. Infestation
9. Decomposing bodies
10. Public health

Task 7. Match the word from the text to the given definition.

1. Animal remains after death – _____
2. Parasite that infects salmon – _____
3. Place where an organism lives – _____
4. Young fish – _____
5. A structure built by beavers – _____
6. Nutrients coming from the ocean – _____
7. Invertebrate in parasite life cycle – _____
8. Condition of salmon affected by sea lice – _____
9. Bacteria or parasites spread in flesh – _____
10. Forest area next to a stream – _____

Task 8. Make sentences with the vocabulary from the text.

Ecosystem, nutrient, carcass, parasite, habitat, dam, infestation, predator, filter feeder, juvenile.

Task 9. Match each term on the left with its definition on the right.

Terms	Definitions
1. Ammocoetes	A. Parasite
2. Henneguya	B. Beaver structure
3. Riparian zone	C. Larvae of lamprey
4. Sea lice	D. Dead salmon remains
5. Estuarine marsh	E. Biological output
6. Productivity	F. Tidal zone
7. Filter feeder	G. Species modifying habitat
8. Beaver dam	H. Streamside forest
9. Carcass	I. Ectoparasites of salmon
10. Ecosystem engineer	J. Larvae feeding strategy

Task 10. Match "what actions these individuals do".

Individuals	Actions
1. Ammocoetes	A. Додають складності до річкових систем
2. Hudson's Bay Company	B. Харчуються молоддю лосося
3. Henneguya parasite	C. Заповнюють водойми
4. Scientists	D. Передають паразита лососям
5. Sea lice	E. Захищаються в неглибоких водоймах
6. Juvenile salmon	F. Будують греблі
7. Lampreys	G. Вивчають паразитів
8. Beavers	H. Викликають інфекції
9. Birds	I. Фільтрують поживні речовини
10. Grizzly bears	J. Переносять туші риб у ліс

Task 11. Choose the extra word in the row (The word that is not related in meaning to the rest).

1. Salmon – Bear – Otter – Cactus
2. Nitrogen – Sulfur – Carcass – Phosphorus

3. Dam – Beaver – River – Desert
4. Lamprey – Parasite – Predator – Mushroom
5. Sea lice – Infection – Foliage – Disease
6. Myxozoan – Henneguya – Copepod – Antibiotic
7. Habitat – Estuary – Pond – Mountain peak
8. Fish – Smolt – Avian – Stream
9. Cycle – Recruitment – Deforestation – Growth
10. Grizzly – Extirpate – Engineer – Construct

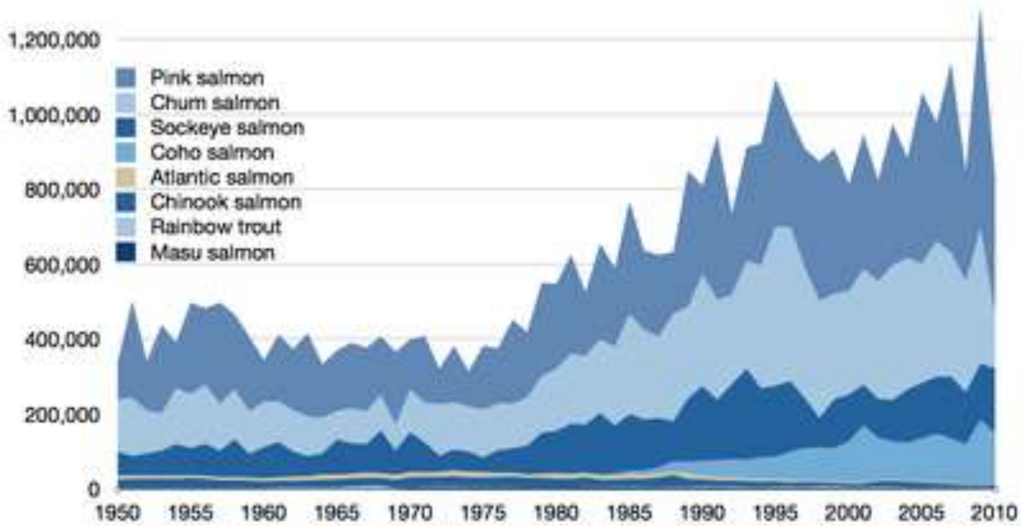
Task 12. Make up as more sentences as you can using the words and expressions from exercise 3.

Task 13. Write a brief summary of the text. Read your summaries of the text to your groupmates.

Task 14. Make up a plan of this text. Retell the text according to it.

TEXT 3
WILD FISHERIES

Task 1. Read the text and be ready to retell it.



Wild fisheries – commercial capture of all true wild salmon species 1950–2010, as reported by the FAO

Commercial

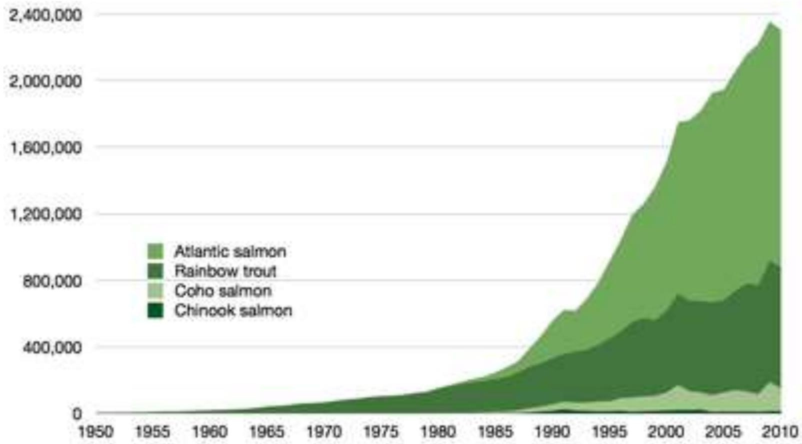
As can be seen from the production chart at the left, the global capture reported by different countries to the FAO of commercial wild salmon has remained fairly steady since 1990 at about one million tonnes per year. This is in contrast to farmed salmon (below) which has increased in the same period from about 0.6 million tonnes to well over two million tonnes. early all captured wild salmon are Pacific salmon. The capture of wild Atlantic salmon has always been relatively small, and has declined steadily since 1990. In 2011 only 2,500 tonnes were reported. In contrast about half of all farmed salmon are Atlantic salmon.

Angler and gillie land a salmon, Scotland

Recreational

Recreational salmon fishing can be a technically demanding kind of sport fishing, not necessarily congenial for beginning fishermen. A conflict exists between commercial fishermen and recreational fishermen for the right to salmon stock resources. Commercial fishing in estuaries and coastal areas is often restricted so enough salmon can return to their natal rivers where they can spawn and be available for sport fishing. On parts of the North American west coast sport salmon fishing completely replaces inshore commercial fishing. The commercial value of a salmon can be several times less than the value of the same fish caught by a sport fisherman. This is "a powerful economic argument for allocating stock resources preferentially to sport fishing."

Farmed salmon



Aquaculture production of all true salmon species 1950–2010, as reported by the FAO

Salmon aquaculture is a major contributor to the world production of farmed finfish, representing about US$10 billion annually. Other commonly cultured fish species include: tilapia, catfish, sea bass, carp and bream. Salmon farming is significant in Chile, Norway, Scotland, Canada and the Faroe Islands; it is the source for most salmon consumed in the United States and Europe. Atlantic salmon are also, in very small volumes, farmed in Russia and the island of Tasmania, Australia.

Salmon are carnivorous. They are fed a meal produced from catching other wild fish and other marine organisms. Salmon farming leads to a high demand for wild forage fish. Salmon require large nutritional intakes of protein, and farmed salmon consume more fish than they generate as a final product. To produce one pound of farmed salmon, products from several pounds of wild fish are fed to them. As the salmon farming industry expands, it requires more wild forage fish for feed, at a time when 75% of the world's monitored fisheries are already near to or have exceeded their maximum sustainable yield. The industrial-scale extraction of wild forage fish for salmon farming affects the survivability of the wild predator fish which rely on them for food.

Work continues on substituting vegetable proteins for animal proteins in the salmon diet. This substitution results in lower levels of the highly valued omega-3 fatty acid content in the farmed product.

Intensive salmon farming uses open-net cages, which have low production costs. It has the drawback of allowing disease and sea lice to spread to local wild salmon stocks.

On a dry weight basis, 2–4 kg of wild-caught fish are needed to produce one kg of salmon.

Rainbow trout farm in an archipelago of Finland

Another form of salmon production, which is safer but less controllable, is to raise salmon in hatcheries until they are old enough to become independent. They are released into rivers in an attempt to increase the salmon population. This system is referred to as ranching. It was very common in countries such as Sweden, before the Norwegians developed salmon farming, but is seldom done by private companies. As anyone may catch the salmon when they return to spawn, a company is limited in benefiting financially from their investment.

Because of this, the ranching method has mainly been used by various public authorities and nonprofit groups, such as the Cook Inlet Aquaculture Association, as a way to increase salmon populations in situations where they have declined due to overharvesting, construction of dams, and habitat destruction or fragmentation. Negative consequences to this sort of population manipulation include genetic "dilution" of the wild stocks. Many jurisdictions are now beginning to discourage supplemental fish planting in favour of harvest controls, and habitat improvement and protection.

A variant method of fish stocking, called ocean ranching, is under development in Alaska. There, the young salmon are released into the ocean far from any wild salmon streams. When it is time for them to spawn, they return to where they were released, where fishermen can catch them.

An alternative method to hatcheries is to use spawning channels. These are artificial streams, usually parallel to an existing stream, with concrete or rip-rap sides and gravel bottoms. Water from the adjacent stream is piped into the top of the channel, sometimes via a header pond, to settle out sediment. Spawning success is often much better in channels than in adjacent streams due to the control of floods, which in some years can wash out the natural redds. Because of the lack of floods, spawning channels must sometimes be cleaned out to remove accumulated sediment. The same floods that destroy natural redds also clean the regular streams. Spawning channels preserve the natural selection of natural streams, as there is no benefit, as in hatcheries, to use prophylactic chemicals to control diseases.

Farm-raised salmon are fed the carotenoids astaxanthin and canthaxanthin to match their flesh colour to wild salmon] to improve their marketability.

One proposed alternative to using wild-caught fish as feed for the salmon is using soy-based products. This should be better for the local environment of the fish farm. But producing soy beans has a high environmental cost for the producing region.

Another possible alternative is a yeast-based coproduct of bioethanol production, proteinaceous fermentation biomass. Substituting such products for engineered feed can result in equal (sometimes enhanced) growth in fish. With its increasing availability, this would address the problems of rising costs for buying hatchery fish feed.

Yet another attractive alternative is the increased use of seaweed. Seaweed provides essential minerals and vitamins for growing organisms. It offers the advantage of providing natural amounts of dietary fiber and having a lower glycemic load than grain-based fish meal. In the best-case scenario, widespread use of seaweed could yield a future in aquaculture that eliminates the need for land, freshwater, or fertilizer to raise fish.

Management

The population of wild salmon declined markedly in recent decades, especially North Atlantic populations, which spawn in the waters of western Europe and eastern Canada, and wild salmon in the Snake and Columbia River systems in northwestern United States.

Salmon population levels are of concern in the Atlantic and in some parts of the Pacific. Alaska fishery stocks are still abundant, and catches have been on the rise in recent decades, after the state initiated limitations in 1972. Some of the most important Alaskan salmon sustainable wild fisheries are located near the Kenai River, Copper River, and in Bristol Bay. Fish farming of Pacific salmon is outlawed in the United States Exclusive Economic Zone, however, there is a substantial network of publicly funded hatcheries, and the State of Alaska's fisheries management system is viewed as a leader in the management of wild fish stocks. In Canada, returning Skeena River wild salmon support commercial, subsistence and recreational fisheries, as well as the area's diverse wildlife on the coast and around communities hundreds of miles inland in the watershed. The status of wild salmon in Washington is mixed. Of 435 wild stocks of salmon and steelhead, only 187 of them were classified as healthy; 113 had an unknown status, one was extinct, 12 were in critical condition and 122 were experiencing depressed populations.

The commercial salmon fisheries in California have been either severely curtailed or closed completely in recent years, due to critically low returns on the Klamath and or Sacramento rivers, causing millions of dollars in losses to commercial fishermen. Both Atlantic and Pacific salmon are popular sportfish.

Salmon populations have been established in all the Great Lakes. Coho stocks were planted by the state of Michigan in the late 1960s to control the growing population of non-native alewife. Now Chinook (king), Atlantic, and coho (silver) salmon are annually stocked in all Great Lakes by most bordering states and provinces. These populations are not self-sustaining and do not provide much in the way of a commercial fishery, but have led to the development of a thriving sport fishery.

As food

Salmon is a popular food. Classified as an oily fish, salmon is considered to be healthy due to the fish's high protein, high omega-3 fatty acids, and high vitamin D content. Salmon is also a source of cholesterol, with a range of 23–214 mg/100 g depending on the species. According to reports in the journal *Science*, farmed salmon may contain high levels of dioxins. PCB (polychlorinated biphenyl) levels may be up to eight times higher in farmed salmon than in wild salmon, but still well below levels considered dangerous. Nonetheless, according to a 2006 study published in the Journal of the American Medical Association, the benefits of eating even farmed salmon still outweigh any risks imposed by contaminants. Farmed salmon has a high omega 3 fatty acid content comparable to wild salmon. The type of omega-3 present may not be a factor for other important health functions.

Salmon flesh is generally orange to red, although white-fleshed wild salmon with white-black skin colour occurs. The natural colour of salmon results from carotenoid pigments, largely astaxanthin, but also canthaxanthin, in the flesh. Wild salmon get these carotenoids from eating krill and other tiny shellfish.

The vast majority of Atlantic salmon available around the world are farmed (almost 99%), whereas the majority of Pacific salmon are wild-caught (greater than 80%). Canned salmon in the US is usually wild Pacific catch, though some farmed salmon is available in canned form. Smoked salmon is another popular preparation method, and can either be hot or cold smoked. Lox can refer to either cold-smoked salmon or salmon cured in a brine solution (also called gravlax). Traditional canned salmon includes some skin (which is harmless) and bone (which adds calcium). Skinless and boneless canned salmon is also available.

Raw salmon flesh may contain *Anisakis* nematodes, marine parasites that cause anisakiasis. Before the availability of refrigeration, the Japanese did not consume raw salmon. Salmon and salmon roe have only recently come into use in making sashimi (raw fish) and sushi.

To the Indigenous peoples of the Pacific Northwest Coast, salmon is considered a vital part of the diet. Specifically, the indigenous peoples of Haida Gwaii, located near former Queen Charlotte Island in British Columbia, rely on salmon as one of their main sources of food, although many other bands have fished Pacific waters for centuries. Salmon are not only ancient and unique, but it is important because it is expressed in culture, art forms, and ceremonial feasts. Annually, salmon spawn in Haida, feeding on everything on the way upstream and down. Within the Haida nation, salmon is referred to as *"tsiin"*, and is prepared in several ways including smoking, baking, frying, and making soup.

Historically, there has always been enough salmon, as people would not overfish, and only took what they needed. In 2003, a report on First Nation participation in commercial fisheries, including salmon, commissioned by BC’s Ministry of Agriculture, Food and Fisheries found that there were 595 First Nation-owned and operated commercial vessels in the province. Of those vessels, First Nations’ members owned 564. However, employment within the industry has decreased overall by 50% in the last decade, with 8,142 registered commercial fishermen in 2003. This has affected employment for many fisherman, who rely on salmon as a source of income.

Black bears also rely on salmon as food. The leftovers the bears leave behind are considered important nutrients for the forest, such as the soil, trees, and plants. In this sense, the salmon feed the forest and in return receive clean water and gravel in which to hatch and grow, sheltered from extremes of temperature and water flow in times of high and low rainfall. However, the condition of the salmon in Haida has been affected in recent decades. Due to logging and development, much of the salmon's habitat (i.e.: Ain River) has been destroyed, resulting in the fish being close to endangered. For residents, this has resulted in limits on catches, in turn, has affected families diets, and cultural events such as feasts. Some of the salmon systems in danger include: the Davidon, Naden, Mamim, and Mathers. It is clear that further protection is needed for salmon, such as their habitats, where logging commonly occurs.

COMPREHENSIVE CHECK

Task 2. Provide Ukrainian equivalents for the following words and expressions, learn them, and use into your retelling.

Mature individuals, significant erosion, significant erosion, mortality, developing embryos, wetlands, natural predation, structural complexity, to nurture salmon juveniles, larvae, heavily infected fish, open-net farms, highly vulnerable, allocating stock resources, a major contributor, nutritional intakes, wild-catch fishing, dietary fiber, essential minerals, non-native alewife, high omega 3 fatty acid content, logging, coastal dwellers, an important creature.

Task 3. Answer the following questions using active vocabulary from the text.

1. What has been the approximate annual capture of commercial wild salmon since 1990?
2. How does the production of farmed salmon compare to wild salmon in recent decades?
3. Which type of salmon dominates wild capture statistics?
4. What was the reported capture of wild Atlantic salmon in 2011?
5. Why is recreational salmon fishing sometimes preferred over commercial fishing?
6. What economic argument supports sport fishing over commercial salmon fishing?
7. Which countries are major producers of farmed salmon?
8. Why do farmed salmon require large amounts of wild forage fish?
9. What are the environmental concerns associated with open-net cage salmon farming?
10. What is the feed conversion ratio (in kg) for farmed salmon on a dry weight basis?
11. How does ranching salmon differ from standard aquaculture?
12. What are spawning channels and how do they benefit salmon reproduction?
13. Why are seaweed and yeast-based feeds being explored for salmon farming?
14. What impact does salmon farming have on the wild predator fish populations?
15. Why is vegetable protein considered less ideal in salmon diets?
16. Which salmon populations are considered abundant and well-managed?
17. What are the causes of declining wild salmon populations in California?
18. Why were salmon introduced into the Great Lakes?
19. What nutritional benefits does salmon offer to humans?
20. How do Indigenous peoples like the Haida relate culturally to salmon?

Task 4. Match each term on the left with its definition on the right.

Terms	Definitions
1. Hatchery	A. A type of healthy fatty acid found in fish
2. Estuary	B. The process of fish laying eggs
3. Redd	C. A place where fish eggs are hatched and raised
4. Open-net cage	D. A pigment responsible for the orange-red color in salmon
5. Feed conversion	E. Small wild fish caught for feeding farmed fish
6. Omega-3	F. The farming of aquatic organisms such as fish, crustaceans, and plants
7. Forage fish	G. The ratio of feed required to produce a unit of fish
8. Spawning	H. Where a river meets the sea, mixing fresh and saltwater
9. Aquaculture	I. A nest dug by salmon in the gravel of streams for egg laying
10. Carotenoid	J. Floating pens in open water used to farm fish

Task 5. Complete the sentence with the correct word.

1. Salmon farming is a form of _____.
2. The fish return to the river to _____.
3. Atlantic salmon are mostly _____ not wild-caught.
4. _____ are small fish used to feed farmed salmon.
5. A _____ is a facility for fish breeding.
6. Sea lice can spread easily in _____ systems.
7. Pacific salmon dominate _____ capture data.
8. The _____ in Alaska are still healthy.
9. Salmon flesh color comes from _____.
10. Recreational fishing often replaces _____ fishing.

Task 6. Fill in the blanks with the contextual vocabulary.

1. ______ salmon populations are in decline.
2. Farmed salmon are usually fed with _____ fish meal.
3. Ocean ranching involves releasing salmon into the _____.
4. _____ is a fishing area where rivers meet the sea.
5. The Kenai and Copper Rivers are located in _____.
6. _____ salmon is common in sushi.
7. Spawning channels help control _____.
8. Salmon farming may cause _____ dilution of wild stocks.

9. PCB levels are higher in _____ salmon.
10. Indigenous groups like the Haida rely on salmon for _____ and tradition.

Task 7. Choose the correct answer for each question.

1. What is the main purpose of a hatchery?
   a) To clean rivers for salmon migration
   b) To breed and raise fish in a controlled environment
   c) To monitor water temperature
   d) To prevent fish from escaping
2. What is a common alternative feed to wild fish in salmon farming?
   a) Sea salt
   b) Crushed krill
   c) Soy-based protein
   d) Coral-based supplements
3. Why are spawning channels created?
   a) To monitor salmon nutrition
   b) To allow fish to swim faster
   c) To improve spawning success by avoiding natural floods
   d) To increase water temperature
4. Which type of salmon is most commonly farmed?
   a) Coho salmon
   b) Atlantic salmon
   c) Pink salmon
   d) Sockeye salmon
5. Which country bans Pacific salmon farming in its Exclusive Economic Zone (EEZ)?
   a) Canada
   b) Norway
   c) United States
   d) Chile
6. What is a risk of releasing farmed salmon into wild rivers?
   a) Overpopulation of rivers
   b) Dilution of wild salmon genetics
   c) Increase in water pollution
   d) Reduction in algae growth
7. What do carotenoids affect in salmon?
   a) Smell
   b) Weight

c) Flesh color
d) Eye size

8. What kind of diet does a carnivorous fish like salmon need?
   a) A diet high in seaweed
   b) A diet rich in protein from animal sources
   c) A purely plant-based diet
   d) A carbohydrate-rich diet
9. What fish species are often stocked in the Great Lakes for sport fishing?
   a) Tilapia and trout
   b) Chinook and Coho salmon
   c) Salmon sharks and herring
   d) Atlantic cod and halibut
10. What term describes the return of salmon to their birthplace to reproduce?
   a) Nesting
   b) Escaping
   c) Feeding
   d) Migration

Task 8. Match the term in Column A with its related word in Column B.

Column A	Column B
1. Salmon	A. Tsiin
2. Haida	B. Healthy fat
3. Redd	C. Eggs
4. PCB	D. Invasive species
5. Omega-3	E. Artificial breeding
6. Sea lice	F. Color
7. Carotenoid	G. Disease
8. Hatchery	H. Spawning
9. Spawning channel	I. Contaminant
10. Alewife	J. Artificial stream

Task 9. Match each cause on the left with its corresponding effect on the right.

Cause	Effect
1. Overfishing	A. Risk of genetic dilution
2. Use of open-net cages	B. Environmentally friendly
3. Logging	C. High omega-3 content

4. Feeding wild fish	D. Better spawning success
5. Sport fishing	E. Restrictions on fishing
6. Habitat improvement	F. Pressure on forage fish
7. Oil-based feed	G. Habitat destruction
8. Hatchery use	H. Decline in wild stocks
9. Salmon population decline	I. Higher economic value
10. Seaweed feed	J. Spread of sea lice

Task 10. Categorize the Terms (Farmed vs Wild Salmon).

Instructions:
Below is a list of 20 terms related to salmon production and ecology. Your task is to categorize each term into one of two groups: *Farmed Salmon* or *Wild Salmon* based on its relevance to either context.
Terms to Categorize:
1. Open-net cage
2. Feed conversion
3. Hatchery
4. Astaxanthin
5. PCB
6. Omega-3
7. Seaweed feed
8. Fish meal
9. Aquaculture
10. Vegetable protein
11. Spawning channel
12. Estuary
13. Predator fish
14. Redd
15. Overfishing
16. Spawning
17. Migration
18. Habitat
19. Bears
20. Indigenous diets

Task 11. Mark true or false.

1. Salmon farming uses entirely plant-based feed.
2. Redds are nests built by salmon.
3. Farmed salmon flesh is naturally pink due to diet.
4. PCB levels are higher in farmed salmon.
5. Spawning channels are natural river branches.
6. Ranching is commonly done by private companies.
7. Alewife was introduced to control salmon.
8. Haida people traditionally smoke salmon.
9. Sport fishing generates less income than commercial fishing.
10. Soy feed reduces omega-3 levels in farmed fish.

Task 12. Make up as more sentences as you can using the words and expressions from Task 2.

Task 13. Write a brief summary of the text. Read your summaries of the text to your groupmates.

Task 14. Make up a plan of this text. Retell the text according to it.

Task 15. Read the text and write a summary.

HISTORY

Seine fishing for salmon – Wenzel Hollar, 1607–1677

The salmon has long been at the heart of the culture and livelihood of coastal dwellers. Many people of the northern Pacific shore had a ceremony to honor the first return of the year. For many centuries, people caught salmon as they swam upriver to spawn. A famous spearfishing site on the Columbia River at Celilo Falls was inundated after great dams were built on the river. The Ainu, of northern Japan, trained dogs to catch salmon as they returned to their breeding grounds *en masse*. Now, salmon are caught in bays and near shore.

The Columbia River salmon population is now less than 3% of what it was when Lewis and Clark arrived at the river. Salmon canneries established by settlers beginning in 1866 had a strong negative impact on the salmon population. In his 1908 State of the Union address, U.S. President Theodore Roosevelt observed that the fisheries were in significant decline:

The salmon fisheries of the Columbia River are now but a fraction of what they were twenty-five years ago, and what they would be now if the United States Government had taken complete charge of them by intervening between Oregon and Washington. During these twenty-five years the fishermen of each State have naturally tried to take all they could get, and the two legislatures have never been able to agree on joint action of any kind adequate in degree for the protection of the fisheries. At the moment the fishing on the Oregon side is practically closed, while *there is no limit on the Washington side of any kind, and no one can tell what the courts will decide as to the very statutes under which this action and non-action result. Meanwhile very few salmon reach the spawning grounds, and probably four years hence the fisheries will amount to nothing; and this comes from a struggle between the associated, or gill-net, fishermen on the one hand, and the owners of the fishing wheels up the river.*

On the Columbia River the Chief Joseph Dam completed in 1955 completely blocks salmon migration to the upper Columbia River system.

The Fraser River salmon population was affected by the 1914 slide caused by the Canadian Pacific Railway at Hells Gate. The 1917 catch was one quarter of the 1913 catch.

Mythology

The salmon is an important creature in several strands of Celtic mythology and poetry, which often associated them with wisdom and venerability. In Irish mythology, a creature called the Salmon of Knowledge plays key role in the tale *The Boyhood Deeds of Fionn*. In the tale, the Salmon will grant powers of knowledge to whoever eats it, and is sought by poet Finn Eces for seven years. Finally Finn Eces catches the fish and gives it to his young pupil, Fionn mac Cumhaill, to prepare it for him. However, Fionn burns his thumb on the salmon's juices, and he instinctively puts it in his mouth. In so doing, he inadvertently gains the Salmon's wisdom. Elsewhere in Irish mythology, the salmon is also one of the incarnations of both Tuan mac Cairill and Fintan mac Bóchra.

Salmon also feature in Welsh mythology. In the prose tale *Culhwch and Olwen*, the Salmon of Llyn Llyw is the oldest animal in Britain, and the only creature who knows the location of Mabon ap Modron. After speaking to a string of other ancient animals who do not know his whereabouts, King Arthur's men Cai and Bedwyr are led to the Salmon of Llyn Llyw, who lets them ride its back to the walls of Mabon's prison in Gloucester.[*citation needed*]

In Norse mythology, after Loki tricked the blind god Höðr into killing his brother Baldr, Loki jumped into a river and transformed himself into a salmon to escape punishment from the other gods. When they held out a net to trap him he attempted to leap over it but was caught by Thor who grabbed him by the tail with his hand, and this is why the salmon's tail is tapered.

Salmon are central spiritually and culturally to Native American mythology on the Pacific coast, from the Haida and Coast Salish peoples, to the Nuu-chah-nulth peoples in British Columbia.

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Навчальне видання

AQUACULTURE

ЕЛЕКТРОННІ МЕТОДИЧНІ ВКАЗІВКИ
до практичних занять та самостійної роботи
з навчальної дисципліни «Англійська мова»
для здобувачів першого року навчання
другого (магістерського) рівня вищої освіти
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Укладач:
Куделіна Ольга Юріївна

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Видавець:
Одеський національний університет імені І. І. Мечникова
вул. Змієнка Всеволода, буд. 2, м. Одеса, 65001, Україна
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Тел.: (048) 723 28 39, e-mail: druk@onu.edu.ua