Ministry of Agriculture of the Republic of Kazakhstan S.Seifullin Kazakh Agrotechnical University

Reviewed by at the meeting of the University Academic Council Minutes № <u>15</u> «<u>30</u> » <u>05</u> 2019 Chairman of the Board Scifully Bazakh Agrotechnical University JSC A.K.Kurishbayev 2019

#### EDUCATIONAL PROGRAM

### "Aquaculture and aquatic bioresources"

Code and classification of education field: 6B08 - <u>Agriculture and bioresources</u> Code and classification of training direction: <u>6B083 - Fisheries</u> Code in the International Standard Classification of Education: <u>0811</u> Qualification: Bachelor of Agriculture in EP"<u>Aquaculture and aquatic bioresources</u>" Studying period: 4 years Form of study: full-time

Nur-Sultan 2019

Update EPVO – 17.08.2023

Academic Committee:

Chairman - Aubakirova Gulzhan Amanzholovna – PhD, ass.professor Members of the Committee:

1. Barinova Gulnaz Kaldybaevna – Candidate of Biological Sciences, acting ass. professor

2. Asylbekova Ainur Serikbayevna – Candidate of Agricultural Sciences, ass. professor

3. Bazhenova Diana Alexandrovna – 3rd year of the OP "Aquaculture and aquatic bioresources"

4. Zhubaev Askhat Bakhtygalievich - Head of the Department of Reproduction of Fish Resources of the Committee of Fisheries of the Ministry of Fisheries of the Republic of Kazakhstan

5. Ayan Kairatovich Bakhiyanov – Deputy Chairman of the Fisheries Committee of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan

The Academic Committee was approved by Order No. 516-N of 04.10.2022 for the S.Seifullin Kazakh Agro Technical Research University.

The educational program "Aquaculture and aquatic bioresources" was reviewed at the meeting of the Department of Hunting and Fisheries Protocol  $N_{2}$  <u>11</u> of "<u>11</u>" <u>05</u> 2023.

approved by the Council of the Faculty of Forestry, Wildlife and Environment Protocol No  $9^6$  "25" 05 2023.

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#### **1** Passport of the educational program

**1.1 The purpose of the educational program**: mastering by students the basics of rational use of aquatic biological resources, methods of intensification and technology of cultivation of aquatic organisms in fish farms.

The main objectives of the program are:

1. provision of conditions for obtaining full-fledged, high-quality professional education;

2. formation of basic professional competences of future specialists of fisheries;

3. creating prerequisites for independent search and research activities of students in the framework of the experiment at all its stages;

4. ability to work with scientific and technical information, to use domestic and foreign experience in professional activity, to systematize and generalize the received information.

#### **1.2 Learning outcomes**

**ON 1.** Possess the basics of economic knowledge, have scientific ideas about management, marketing, finance, the role of the public sector in the economy. Know how to solve systems of linear equations, problems related to matrices and study and solve engineering problems. Analyze the conditions of production development in logical and quantitative accounting, study innovative entrepreneurship and anti-corruption culture, formulate inventions.

**ON 2.** Have an idea about cell division, fertilization, patterns and laws of heredity, chromosomal theory of fish heredity. Know the types of invertebrates and vertebrates, their structure, patterns of settlement, the relationship with the environment. Have research skills in fish physiology. Understand the structure features of biomolecules, sugars, nucleotides, nucleic acids, fatty acids, vitamins and trace elements.

**ON 3.** To know the life forms of hydrobionts, the systematic position of fish in the systematics of the animal world, the morphology, ecology and anatomy of fish, the biology of fish, as well as the peculiarities of the development of embryos, the development of germ cells – gametogenesis, morphology and physiology of gametes. To determine the species diversity, systematics, structure of coastal aquatic plants. Be able to use agro-climatic and agrometeorological information for conducting fish-breeding activities.

**ON 4.** To know the patterns of interaction of aquatic organisms, ecological groupings of hydrobionts, features of natural waters, hydrochemical composition of natural waters, patterns of its changes depending on chemical, physical and biological processes. To study the structure, physiology, biochemistry of microorganisms, general characteristics of viruses. Use mathematical methods of statistical analysis in relation to biological objects. Know the ecosystem of the aquatic environment.

**ON 5.** Possess knowledge about the basics of the formation of production processes in the reservoir, autotrophic and heterotrophic nutrition. To know the concept of feed resources of the reservoir, compound feed and their characteristics, the development of a recipe for fish feed. Be able to use the most effective methods of growing fish in the RAS. Analyze methods to ensure favorable conditions, safety of workers and labor organization.

**ON 6.** Know the legislative framework in the field of fisheries and conservation of aquatic biological resources, breeding and cultivation of fish in special fish-breeding tanks, as well as valuable species in lake-commodity farms. Be able to set research goals, conduct morphobiological analysis of fish, process and summarize the results obtained. Have an idea of the biological basis of natural and artificial reproduction of fish.

**ON 7.** Have an understanding of the mechanisms of fish behavior, their reaction to natural and artificial physical stimuli. Know about the current distribution of the fauna of hydrobionts and other animals. Evaluate the general principles of fish stocks protection, chemical composition and nutritional value of fish meat, organoleptic, post-mortem changes in raw materials and principles of its preservation, fish processing. Possess knowledge about the technology of growing whitefish.

**ON 8.** Have an idea of modern technologies of artificial reproduction and cultivation of aquatic organisms, forms of intensive fisheries, industrial methods of fish cultivation. Understand the classification of fishing gear, the organization of fishing in inland waters. To know the basics of general pathology, parasitology, epizootology, preventive and therapeutic measures, theoretical methods for studying the dynamics of the number of fish, age, size and sex structure of the fish population.

**ON 9.** Possess knowledge about the design features of spawning, lake-commodity, industrial farms, the construction of the head hydrotechnical node, the construction of water supply and drainage networks of fish-breeding enterprises, technical operation of hydraulic structures of fish-breeding enterprises. To know the objects of pond fish farming, the types of pond farms, the technology of keeping and growing carp, whitefish, salmon, catfish and other fish in pond farming conditions.

**ON 10.** Have some knowledge about aquariums and the technology of growing ornamental fish. Know the breeding and commercial cultivation of seaweed, invertebrates, fish under controlled conditions. Possess knowledge about water pollution and periodic mapping of water quality by physico-chemical and biological characteristics. Know the toxicity of the aquatic environment, as well as the patterns of reactions of aquatic organisms of different systematic positions.

# 2. General characteristics of the educational program (relevance, features, competitive advantages, uniqueness, stakeholders, etc.)

The educational program "Aquaculture and aquatic bioresources" was created in accordance with the Law of the Republic of Kazakhstan dated July 9, 2004 "On the protection, reproduction and use of wildlife", taking into account the request of employers. This educational program solves the main problems of conservation and rational use of aquatic biological resources.

The relevance of the educational program lies in the fact that it reflects the issues of environmental protection in the field of protection of aquatic biological resources and fisheries management, taking into account modern realities.

The peculiarity of this educational program is that it takes into account the world experience in the field of aquaculture and the organization of fisheries (University of Eastern Finland, University of Putra Malaysia, Novosibirsk State Agrarian University), as well as taking into account the work and proposals of UNDP, ACBK, etc.

The competitive advantage of the educational program is that, based on the experience of various countries, this OP is aimed at solving issues of protection and rational use of aquatic biological resources and the development of aquaculture in the Republic of Kazakhstan.

The uniqueness of the educational program lies in the fact that it reflects significant tasks in the field of fisheries development with the use of modern innovative technologies, the introduction of new aquaculture facilities for the Republic of Kazakhstan. For the implementation of the educational program, there is an appropriate material and technical base (Scientific Research Center "Fisheries", educational and production hunting and fishing farm "Dudaray", UAZ cars, devices for monitoring living objects, swim. tools, fishing gear, expedition gear, etc.), as well as bases of practices provided by employers such as the Fisheries Committee of the Ministry of Ecology and natural resources of the Republic of Kazakhstan, interregional basin inspection of fisheries of the fisheries committee of the ministry of ecology, and natural resources of the republic of Kazakhstan", <u>LLP "Scientific and production center of fisheries"</u>, ALE "Kazakhrybkhoz", LLP "Fish nursery "Maybalyk", oceanarium "Ailand", SNR "Korgalzhyn" and other entities in the field of fisheries.

#### 3. Competence model (portrait) graduate

**3.1 Areas of professional activity** - Fisheries Committee of the Ministry of Ecology and natural resources of the Republic of Kazakhstan; fish farms; fishing organizations and enterprises; research institutes; environmental organizations; fish processing enterprises.

**3.2 Types of professional activity:** taxonomic determination of aquatic biological objects, quantitative and qualitative accounting of aquatic organisms, biological and morphological characteristics of fish; determination of biological productivity of reservoirs, breeding of fish and economically valuable aquatic organisms in natural and artificial reservoirs; obtaining sexual products and insemination of eggs; biological provision of conditions for incubation of eggs and rearing of juvenile fish; intensification of fish breeding processes; organization of fishery reclamation; organization of industrial fishing of aquatic organisms; organization of breeding and breeding work; organization and operation of fish-breeding enterprises of all types; conducting experiments to study the species composition of productivity of reservoirs and ways of infection of fish diseases; study, monitoring, protection and fishing of fish and other aquatic biological resources in the inland waters of Kazakhstan.

#### **3.3 General education competencies**

Upon completion of the study of the compulsory disciplines of the cycle of general education disciplines, the student will be able to:

1) to collect and interpret information for the formation of judgments taking into account social, ethical and scientific considerations;

2) evaluate the surrounding reality on the basis of worldview positions formed by knowledge of the fundamentals of philosophy, which provide scientific understanding and study of the natural and social world by methods of scientific and philosophical cognition;

3) to show a civic position based on a deep understanding and scientific analysis of the main stages, patterns and peculiarities of the historical development of Kazakhstan;

4) apply knowledge and understanding of facts, phenomena, theories and complex dependencies between them in the field under study;

5) understand the importance of the principles and culture of academic integrity.

**3.4 Basic competencies** based on the results of teaching basic disciplines, the student must:

1) demonstrate knowledge and understanding in the field of fisheries based on advanced knowledge of this field;

2) apply knowledge and understanding at a professional level, formulate arguments and solve problems in the field of fisheries;

3) apply theoretical and practical knowledge to solve educational, practical and professional tasks in the field of fisheries;

4) training skills necessary for independent continuation of further training in the field of fisheries;

5) know the methods of scientific research and academic writing and apply them in the field of fisheries;

**3.5 Professional competencies** during the implementation of the OP, the student acquires the following competencies:

#### Know and understand:

- organization, planning and direct implementation of a complex of works on artificial breeding, cultivation and acclimatization of valuable economic species of fish and invertebrates;

- organization and planning, direct implementation of a complex of works on protection and control of rational use of natural biological resources;

- biology and fishing features of the main objects of fish farming and fishing, their ecology;

- hydraulic structures of fish-breeding enterprises, their technical operation, technical justification of fishery construction;

- achievements of science and technology, advanced domestic and foreign experience in the relevant work performed, areas of knowledge;

#### Be able to:

- apply the acquired knowledge to solve specific scientific, practical, information retrieval, methodological and educational tasks;

- use modern methods of studying natural phenomena and processes;

- to determine the practical significance of populations of commercial fish species;

#### Acquire practical skills:

- apply the methodology of field and laboratory ichthyological and hydrobiological studies;

- apply methods for assessing fish stocks, bonitization of reservoirs.

**4** The base of passing professional practices (all types of practices). In the process of implementing the OP, students undergo training practice in the discipline of ichthyology and hydrobiology at the end of the 2nd year in the field. The training practice will be conducted under the guidance of a teacher of the department on the basis of the reservoirs of the Akmola region (Koyandy reservoir, Astana, Lake Zhaltyrkol, Uyaly-Shalkar, Yesil River) and on the fish ponds of Maybalyk Fish Nursery LLP. Departure to the listed reservoirs will be carried out according to the agreement with the Republican State Institution Esil interregional basin inspection of fisheries of the fisheries committee of the ministry of ecology and natural resources of the republic of Kazakhstan".

To consolidate theoretical knowledge, the graduating department organizes industrial and pre-graduate practice. The main bases of practices for passing professional practices are the SIC "Fisheries", LLP "Scientific and production center of fisheries", LLP "Fish nursery "Maybalyk", NGO "Society of Hunters and Fishermen of Astana and Akmola region", LLP "Halyk-balyk", "Zerendinsky Fishery Enterprise", LLP "Kazakh Osseter", LLP "Karaganda fish nursery", East Kazakhstan regional Public Association of hunters and fishermen, oceanarium "Ailand".

№	Name of cycles and disciplines	Total labo	or intensity
			в академических кредитах
1	2	3	4
1	Cycle of general education subjects	1680	56
1)	Core subjects	1530	51
	History of Kazakhstan	150	5
	Philosophy	150	5
	Foreign language	300	10
	Kazakh (Russian) language	300	10
	Information and communication technologies (in English)	150	5
	Module of socio-political knowledge (sociology, political science, cultural studies, psychology)	240	8
	Physical education	240	8
2)	Electives component	150	5
	Basic of economics / Basics of anti-corruption culture / Fundamentals of business	150	5
2	Cycle of Base requirements	3090	103
1)	University component	1500	50
	Fish genetics	150	5
	Zoology	180	6
	Fish physiology	120	4
	Biochemistry	120	4
	Ichthyology	150	5
	Fish embryology	120	4
	Hydrobiology	150	5
	Mathematics	120	4
	Biological bases of fish farming	120	4
	Zoogeography of reservoirs in Kazakhstan	150	5
	Educational practice	120	4
2)	Electives component	1590	53
	Hydrochemistry /Microbiology and Virology	120	4
	Structure and taxonomy of coastal plants /Meteorology	150	5
	Protection of water bioresources / Basics of legislation in fishery	150	5
	Fundamentals of research in fisheries / Lake commercial	150	5

# 5 Structure of the Bachelor's degree program

	fish farm		
	Breeding of decorative fishes /Sanitary hydrobiology	150	5
	Fish ethology /Ichthyogeography	150	5
	Particular Ichthyology /Aquatic Ecosystem	150	5
	Technology of processing of fish products /Whitefish cultivation	150	5
	Biological efficiency of reservoirs /Operation recirculation installations	150	5
	Ecology and life safety /Labor protection and basics of life safety	120	4
	Mariculture /Toxicology of reservoirs	150	5
3	Cycle of profession requirements	2190	73
1)	University component	1860	62
	Aquaculture	150	5
	Technology of cultivation of hydrobionts	150	5
	Fishing	150	5
	Theory of formation of fish stocks	150	5
	Fishery design	120	4
	Fishery hydraulic engineering	120	4
	Ichthyopathology	150	5
	Industrial fishfarming	180	6
	Feed and feeding of fish in aquaculture	150	5
	Internship	390	13
	Pre diploma practice	150	5
2)	Electives component	330	11
	Piscine fish breeding /Trout breeding	150	5
	Artificial reproduction of fishes/ Sturgeon culture	180	6
4	Additional courses		
1)	Electives component		
	Military training		
5	Final certification	240	8
1)	Writing and defending a thesis, graduation project, or preparing and passing a comprehensive exam	240	8
	Total	7200	240

Appendix 1. Academic Calendar

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Appendix 1 to the Academic Calendar

Approved by the Academic Council of the NJSC "S.Seifullin KATIUS", Protocol Ne16, of 26.05.2023 y.

#### Schedule of the educational process for the 2023-2024 academic year for the educational programs of the Faculty of "Forestry, Wildlife and the Environment"

BACHELOR

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# Appendix 2. Working curriculum

#### WORKING CURRICULUM for 2023-2027 asademic year For the modular education program "Aguaculture and aquatic resources" by the speciality/group of educational programmes B080 – Fish industry Degree: Bachelor Form of education: Full-time (bachelor 4 years) semester Entry year: 01-09-2023

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Module code	Module name	Discipline cyd Discipline com	Code of subje	Subject name	Academic cred	Academic stud	Exams	Differentiated	Teon թորա իր	Total	Lethers	Laboratory trainings	Practice	Studio lescons	Practice	Independent v of students via faculty staff	Independent <b>1</b> of students	15	15	15	15	15	15	15	15
	1	anlag	MDN: 1100	W				. Gen	erai mocu	18		1		1		- 20		6.0							
-	-	CELCS	KRY4 1102	Kazakh (russian) language	2	+	+ +		-	5/150			45			20	83	5.0						──′	<u> </u>
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-	Public discipline	20 20	FS1 2107	Dhilosophy	5	4	4			5/150	15	<u> </u>	30			20	85	5.0			5.0			<u>├</u> ──┦	<u> </u>
- 7		80 20	FH 2107	Philosophy Division administration	2	<b>T</b>		1	-	2/60	15		30			<u>20</u> 8	22	2.0			5.0			<u>├───</u> /	<u> </u>
- é	1	GECS	FK 1114	Physical education Devoicel adjustion	2	5	+	2	+	2/60		+	30			, e	22	2.0	2.0					<u>├</u> ──┦	<u> </u>
, č	Physical education	GECS	FK 2116	Physical education	2	1		1 2	+	2/60			30			× ×	22		2.0	2.0				<u>                                     </u>	<u> </u>
10	1	GELCS	FK 2117	Physical education	2	4		4	-	2/60			30			8	22			4.0	2.0			- · · ·	(
11	Information - communication	GECS	IKT 1106	Information and communication technologies	5	2	2	· · ·		5/150	15	30.0				20	85		5.0		2.0				
12		GECS	PS 1111	Political science and sociology	4	2	2			4/120	15		30			16	59		4.0						
13	Socio-political knowledge	GECS	KP 1112	Cultural studies and psychology	4	2	2			4/120	15		30			16	59		4.0						
14		GE ES	OAK 2123	Basics of anti-corruption culture			4			5/150	15		30			20	85								
15	Law and Economics	GE ES	OPD 2124	Fundamentals of business	5	4	4			5/150	15		30			20	85				5.0				
16	1	GE ES	OEP 2125	Basics of economics and law	1		4			5/150	15		30			20	85								
							M	lodules of speci	aliy/educa	tion prog	գատո														
17		BS UC	Zoo 1250	Zoology	6	1	1		_	6/1 <u>80</u>	30		30			24	96	6.0							
18		BS UC	FR 2230	Fish physiology	4	3	3			4/120	15	30:0				16	59			4.0				<u> </u>	
19	Biological	BS UC	Bio 2230	Biochemistry	4	3	3			4/120	15	30,0				16	59			4.0					
20	_	BS ES	ChI 3267	Particular Ichthyology	- A -	5	5			5/150	15		30			20	85					5.0		$\square$	$\square$
21		BS ES	VE 3270	Aquatic ecosystem			3			5/150	15		30	_		20	85					5.0		$\square$	$\vdash$
22	_	BS UC	BOR 1262	Biological bases of fish farming	4	1	1			4/120	15		30			16	59	4.0						<u> </u>	L
23	4	BS UC	Gid 2222	Hydrobiology	5	3	3			5/150	15	30.0			L	20	85			5.0				′	└──
24	Hydrology and bioresources	BS UC	ZVK 2263	Zoogeography of reservoirs in Kazakhstan	5	3	3			5/150	15		30			20	85			5.0				$\vdash$	<b>—</b>
25		BS UC	lht 2223	Iduthyology	S	4	<b>4</b>			5/150	15	30.0				20	85				5.0			$\vdash$	<u> </u>
26	4	BS UC	UP 2207	Educational practice	4	4	-			4/120					120						4.0			—	<u> </u>
27		BS UC	ER 3221	Fish embryology	4	5	5			4/120	15	30.0				16	59					4.0		—	<b></b>
28	4	BS ES	Gid 1216	Hydrochemistry	4	1				4/120	15	30.0				16	59	4.0	<u> </u>					—	<b></b>
29	-	BS ES	MV 1235	Microbiology and Virology			1		-	4/120	15	30.0	- 20			10	- 29		10					—	L
30	Natural Sciences	BS UC	Mat 1264	Mathematics	4	2	2		-	4/120	15		30			10	59		4.0					──′	<u> </u>
31	4	DC EC	55PVR 2230	Structure and taxonomy of coastal plants	5	3				5/150	15		30			20	85			5.0				—	<u> </u>
- 34	-	DC UC	DOLET 2241	Intereorology		<b>.</b>	1 °		-	5/150	15		30			20	83				6.0			───′	L
24		D0 00	UK 2249	Fish genetics	-	+ *	7	+	+	A/100	15	+	20	<u> </u>	<u> </u>	20 16	50				5.0			───′	i
25	4	DO DO	070276	Lobor protection and basics of life safety	4	3		+	+	4/120	15	+	20	<u> </u>	<u> </u>	10	50			4.0				───′	i —
36	Fish industry	BS FC	FT17V 3271	Operation reciprolation installations			6	+	-	5/150	15	-	30	-		20	- 29							<u>├</u> ───	<u> </u>
37	1	BS ES	BV 3272	Biological efficiency of settorio	5	6	6	+	+	5/150	15		30		<u> </u>	20	85						5.0	'	<u> </u>
38	1	AS UC	KKRA 4321	Feed and feeding of fish in amaculture	5	7	2	+	+	5/150	15	<u> </u>	30			20	85							5.0	<u> </u>

40	I BS   ES   ONTRH 3214	The dam and to she could be fide at a		-																			
40	DO DO CILICIDATI	Fundamentals of research in fisheries	5	5	5			5/150	15		30			20	85					50			
	BS ES OTRH 3244	Lake commercial fish farm		<u> </u>	5			5/150	15		30			20	85					5.0			
41 Fichary activities	BS ES 0VB 4252	Protection of water bioresources		2	1			5/150	15		30			20	85							50	
42 Fishery activities	BS ES OZRH 4256	Basics of legislation in fishery	5	L (	7			5/150	15		30			20	85							5.0	
43	AS UC Ryb 3304	Fishing	5	6	6			5/150	15		30			20	85						5.0		
14	AS UC TFRZ 4305	Theory of formation of fish stocks	5	7	7			5/150	15		30			20	85							5.0	
+5	BS ES TPRP 3260	Technology for processing of fish products			5			5/150	15		30			20	85					5.0			
5	BS ES Sig 3261	Whitefish cultivation	] '	<sup>'</sup>	5			5/150	15		30			20	85					5.0			
47	BS ES ER 3229	Fish ethology	c.	6	6			5/150	15	30.0				20	85						6.0		
8	BS ES Int 3243	Ichthygeography	] '	l °	6			5/150	15		30			20	85						5.0		
19	BS ES DR 4228	Breeding of decorative fishes		•	8			5/150	15		30			20	85								5.0
50	BS ES SG 4268	Sanitary hydrobiology	]	l °	8			5/150	15		30			20	85								5.0
51 Electronic	AS UC PP 3306	Intenship	8	6				8/240					240								8.0		
52 Fish soming	AS UC IR 4322	Industrial fishfarming	6	7	1			6/180	30		30			24	96							6.0	
53	AS ES PR 4319	Piscine fish breeding			7			5/150	15		30			20	85								
54	AS ES For 4320	Trout breeding	1 2	1 '	7			5/150	15		30			20	85							1 5.0	
55	AS UC PP 4308	Pre diploma practice	5	8				5/150					150										5.0
56	AS UC PP 4309	Intenship	5	8				5/150					150										5.0
57	AS ES IVR 4316	Artificial reproduction of fishes		· .	8			6/180	30		30			24	96								
58	AS ES Ose 4318	Stargeon breeding	1°	8	8			6/180	30		30			24	96								1 0.0
59	AS UC Akv 2312	Aquiculture	5	4	4			5/150	15		30			20	85				5.0				
60	AS UC PRH 3313	Fishery design	4	5	5			4/120	15		30			16	59					4.0			
51 Aquaculture	AS UC RG 3314	Fishery hydraulic engineering	4	5	5			4/120	15		30			16	59					4.0			
52	AS UC Int 3315	Ichthypathology	5	5	5			5/150	15	30.0				20	85					5.0			
3	AS UC TVG 3311	Technology of cultivation of hydrobionts	5	6	6			5/150	15		30			20	85						5.0		
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64	BS ES Mar 4273	Mariculture	5	1	7	Modu Scientif	les of ch ically re	ia guann iaice search 5/150	15		30			20	85							5.0	
64 65	BS ES Mar 4273 BS ES TV 4274	Mariculture Toxicology of reservoirs	5	1	7	Modu Scientif	ies of ch ically re	search 5/150 5/150	15 15		30 30			20 20	85 85							5.0	
64 65	BS ES Mar 4273 BS ES TV 4274 Weekdy average wurdtoad	Mariculture Toxicology of reservoirs <b>at hours</b>	5	7	7	Modu Scientif	ies of ch ically re	oice search 5/150 5/150	15 15		30 30			20 20	85 85	62	58	58	62	64	56	5.0	42
64 65 1	BS ES Mar 4273 BS ES TV 4274 Weekly average workload General education su	Mariculture Toxicology of reservoirs at hours bjects(GER)	5	7	7	Modu Scientif	les of ch ically re 0	oice search 5/150 5/150 1680	15 15 90	30	30 30 <b>450</b>	0	Û	20 20 224	85 85 886	62 17	58 25	58 2	62 12	64 0	56 0	5.0 62 0	42
64 65 1	ES ES Mar 4273 ES ES TV 4274 Weekly average worldoad General education su Core subjects(63	Mariculture Toxicology of reservoirs at hours Djects(GER) ER/CS)	5 56 51	7	7 10 9	Midital Andrea Modu Scientif 4 4	les of ch ically re 0	oice search 5/150 5/150 1680 1530	15 15 90 75	<b>30</b> 30	30 30 <b>450</b> 420	<b>0</b>	<b>U</b> 0	20 20 224 204	85 85 <b>886</b> 801	62 17 17	58 25 25	58 2 2	62 12 7	64 0 0	56 0 0	5.0 62 0	42 0
64 65 1	ES ES Mar 4273 ES ES TV 4274 Weddy average wordoad General education su Core subjects(67 University componen	Mariculture Toxicology of reservoirs at hours bjects(GER) BjeCCS) a(GER/UC)	5 56 51 0	7	7 10 9 0	Mođu Scientif 4 4 0	les of ch ically re 0 0	sice search 5/150 5/150 1680 1530 0	15 15 90 75 0	<b>30</b> 30 0	30 30 <b>450</b> 420 0	0 0 0	<b>0</b> 0	20 20 224 204 0	85 85 886 801 0	62 17 17 0	58 25 25 0	58 2 2 0	62 12 7 0	64 0 0	56 0 0	5.0 62 0 0	42 0 0
64   65   1	BS ES Mar 4273 BS ES TV 4274 Weddy average workload General education su Core subjects(G University componen Electives(GES	Mariculture Toxicology of reservoirs at hours bjects(GER) ER/CS) (CER/UC) VES)	5 56 51 0 5	7	7 10 9 0 1	Modu Scientif 4 4 0 0	les of ch ically re 0 0 0	xxice xxice xxice 5/150 5/150 1680 1530 0 150	15 15 90 75 0 15	30 30 0 0	30 30 450 420 0 30	0 0 0 0	0 0 0 0	20 20 224 204 0 20	85 85 886 801 0 85	62 17 17 0 0	58 25 25 0 0	58 2 2 0 0	62 12 7 0 5	64 0 0 0	56 0 0 0	5.0 62 0 0 0	42 0 0 0
64 65 1 2	BS ES Mar 4273 BS ES TV 4274 Weddy average worldoad General education su Core subjects(FF University componen Electives(GER Base requireme	Mariculture Toxicology of reservoirs at hours bjects(GER) ER/CS) d(GER/UC) MSS) nts(B S)	5 56 51 0 5 103	7	7 10 9 0 1 21	Modu Scientif 4 0 0 0	les of ch ically re 0 0 0 0	soice search 5/150 5/150 1680 1530 0 150 3090	15 15 90 75 0 15 330	30 30 0 210	30 30 450 420 0 30 420	0 0 0 0 0	0 0 0 0 120	20 20 224 204 0 20 396	85 85 886 801 0 85 1614	62 17 17 0 0 14	58 25 25 0 0 4	58 2 2 0 0 27	62 12 7 0 5 14	64 0 0 0 19	56 0 0 0 10	5.0 62 0 0 0 10	42 0 0 0 0 5
64 65 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	BS ES Mar 4273 BS ES TV 4274 Weddy average workload General education su Core subjects(GF University componen Electives(GER Base requireme Core subjects(B	Mariculture Toxicology of reservoirs at hours bijects(GER) ER/CS) d(GER/UC) //ES) ts(GS)	5 56 51 0 5 <b>103</b> 0	7	7 10 9 0 1 21 0	Modu Scientif 4 4 0 0 0	les of ch ically re 0 0 0 0 0	soice search 5/150 5/150 1680 1530 0 150 3090 0	15 15 90 75 0 15 330 0	<b>30</b> 30 0 <b>210</b> 0	30 30 450 420 0 30 420 0	0 0 0 0 0 0 0 0	0 0 0 120 0	20 20 224 204 0 20 396 0	85 85 801 0 85 1614 0	62 17 17 0 0 14 0	58 25 25 0 0 4	58 2 2 0 0 27 0	62 12 7 0 5 14 0	64 0 0 0 19 0	56 0 0 0 10 0	5.0 62 0 0 0 0 10 0	42 0 0 0 5 0
64 65 1 2	BS ES Mar 4273 BS ES TV 4274 Weddy average workload General education su Core subjects(G University componen Electives(GEF Base requireme Core subjects(B University componen	Mariculture Toxicology of reservoirs at hours bjects(GER) ER/CS) d(GER/UC) /ES) dt(SER) s/CS) bj(CS) htt(BS/UC)	5 56 51 0 5 <b>103</b> 0 50	7	7 10 9 0 1 21 0 10		les of ch ically re 0 0 0 0 0 0	s/150 5/150 5/150 1680 1530 0 150 3090 0 1500	15 15 75 0 15 <b>330</b> 0 165	30 30 0 210 0 150	30 30 450 420 0 30 420 0 150	0 0 0 0 0 0 0 0 0	0 0 0 120 120	20 20 224 204 0 20 396 0 184	85 85 886 801 0 85 1614 0 731	62 17 17 0 14 0 10	58 25 25 0 0 4 0 4	58 2 2 0 0 27 0 18	62 12 7 0 5 14 0 14	64 0 0 0 19 0 4	56 0 0 0 10 0 0	5.0 62 0 0 0 0 10 0 0	42 0 0 0 5 0 0
64 65 1 2	BS     ES     Mar 4273       BS     ES     TV 4274       Weedy average worldoad       Cone subjects(H       University componen       Electives(GER       Base requiremen       Core subjects(E       University componen       Electives(GER       Base requiremen       Core subjects(E       University componen       Electives(CER)	Mariculture Toxicology of reservoirs at hours Djects(GER) ER/CS) d(GER/UC) /ES) st/CBS) st/CS) st/CS) th(BS/UC) ES)	5 56 51 0 5 <b>103</b> 0 50 53	7	7 10 9 0 1 21 0 10 11	Module           Module           Scientif           4           4           0           0           0           0           0           0           0           0           0           0           0           0           0	les of ch ically re 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	s/150 5/150 5/150 1680 1530 0 150 3090 0 1500 1590	15 15 90 75 0 15 330 0 165 165	30 30 0 210 0 150 60	30 30 450 420 0 30 420 0 150 270	0 0 0 0 0 0 0 0 0	0 0 0 120 0 120 0	20 20 224 204 0 20 396 0 184 212	85 85 886 801 0 85 1614 0 731 883	62 17 17 0 0 14 0 10 4	58 25 25 0 0 4 0 4 0	58 2 2 0 0 27 0 18 9	62 12 7 0 5 14 0 14	64 0 0 0 19 0 4 15	56 0 0 0 10 0 0 10	5.0 62 0 0 0 10 0 0 10	42 0 0 0 5 0 0 5
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N⁰	Name of the discipline	Short description of the discipline	Num				Genera	ted lea	rning ou	itcomes			
	_	(30-50 words)	ber	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
			of	1	2	3	O 4	5	O 6	7	8	9	10
			credi										
			ts										
		Cycle of general education subjects											
		Electives component											
1	Basic of economics/	The subject of economic theory and research methods.	5	V									
	Basics of anti-	Foundations of social production and a social economy											
	corruption culture/	form. A mechanism of the functioning of market											
	Fundamentals of	systems. Production, costs and income of the company.											
	business	National economy. Economic growth and market											
		instability. Inflation and unemployment - a											
		manifestation of economic instability. Financial and											
		monetary system in the national economy and economic											
		security.											
		Basics of anti-corruption culture. The discipline											
		explores the theoretical and methodological foundations											
		of the concept of "corruption" and examines the											
		improvement of socio-economic relations of the Kazakh											
		society as a condition for combating corruption,											
		psychological features of the nature of corrupt behavior,											
		the formation of anti-corruption culture, features of the											
		formation of anti-corruption culture of youth, ethnic											
		features of the formation of anti-corruption culture,											
		moral and ethical responsibility for acts of corruption in											
		various spheres. The discipline allows you to learn											
		about the legal responsibility for corruption offenses.											
		Fundamentals of busines. The subject of the basics of											
		entrepreneurship. The concept of entrepreneurship											
		under the legislation of the Republic of Kazakhstan.											
		Ownership in the Republic of Kazakhstan. Legal status											
		of legal entities. Property rights. Private											

# Appendix 3. Matrix of achievability of the formed learning outcomes according to the educational program with the help of academic disciplines

		entrepreneurship. Individual entrepreneurship. Licensing of entrepreneurial activity. Legal regime of foreign investments.							
		Cycle of base requirements							
		University component					 		
2	Biochemistry	The discipline of biochemistry studies the features of the structure of biomolecules (amino acids, peptides, proteins), sugars, nucleosides, nucleic acids, fatty acids, vitamins and trace elements; the chemical foundations of biological processes and the most important principles of molecular logic of the living; the main chemical components of the cell, the molecular	4	V		V			
		foundations of biocatalysis and heredity.							
3	Fish genetics	The discipline studies the basic patterns of inheritance of traits and the principles of heredity of fish. Chromosomal theory of fish heredity. Molecular bases of heredity. Sex determination and some issues of hormonal regulation of sex in roundworms and fish, mutation process and various types of mutation, some molecular aspects of regulation of gene expression in fish and other eukaryotes.	5	V					
4	Hydrobiology	Discipline studies the physicochemical conditions of the aquatic population, the hydrosphere, continental water bodies and their populations, as well as the biological production of aquatic ecosystems and ways to increase it.	5	V	V	V			
5	Zoology	Studies the fitness and regularity of the distribution of various animals on Earth, their systematics, the origin of various animal species, ways of development, the diversity of animals, their role in nature, animal ecology. Examines the species of invertebrates and all types of vertebrates.	6	V		V			
6	Ichthyology	The discipline studies the development of ichthyology, systematics and anatomy, external and internal	5	V	V				

		structure, skeleton and muscular system, biology and									
7	Biological bases of fish	The discipline studies the state and prospects of fish	4					 V			
/	farming	farming the importance of fish farming in the	-					v			
	imining	conservation and increase of fish stocks the biological									
		foundations of various links of natural and artificial									
		reproduction of fish.									
8	Mathematics	The course covers all the necessary sections of	4	V			V				
		mathematics: elements of mathematical logic and									
		number theory; linear algebra; vector algebra, analytic									
		geometry, differential and integral calculus of functions									
		of one and several variables, differential equations,									
		multiple integrals, series theory, introduction to									
		probability theory and mathematical statistics, solving									
		mathematical problems using computer programs									
9	Zoogeography of	The discipline studies the distribution of hydrobionts	5		V				V		
	reservoirs in	and other animals in the reservoirs of Kazakhstan. The									
	Kazakhstan	main objects of zoogeography are faunas and habitats.									
		She studies the distribution of fish species and other taxa									
		in Kazakinstan, studies the distribution of fauthal									
		complexes, as well as the processes of settlement and									
		reduction of their ranges									
10	Fish physiology	The discipline studies the physiological processes of the	1		V		V				
10	r isii piiysiology	gastrointestinal tract respiratory excretory nervous	4		v		v				
		endocrine and other systems of the fish body as well as									
		their specific features.									
11	Fish embryology	Discipline studies the characteristics of embryo	4			V					
		development, also the development of germ cells -									
		gametogenesis, morphology and physiology of gametes,									
		fertilization, explores the causes and mechanisms of									
		morphological processes and the relationship of									
		organisms with the environment.									
		Cycle of base req	uiremei	nts							

		Electives com	ponent							
12	Fish ethology/	The discipline studies the mechanisms of fish behavior	5				V	V		
	Ichthygeography	and the possibility of using them in fishing and fish								
		farming, the study of fish reception organs and the								
		peculiarities of their perception of physical fields, fish								
		reactions to artificial and natural physical fields, as well								
		as their use in fish farming.								
		The discipline studies the idea of the modern								
		distribution of fish fauna, shows the causes and patterns								
		of settlement and origin of ichthyogeographic						V		
		complexes, identifies the reasons for the differences								
		between the ichthyofauna of the regions of the World								
		Ocean and continental reservoirs.								
13	Biological efficiency	Biological efficiency of reservoirs. The discipline	5			V				
	ofreservoirs /	studies the basics of the formation of production								
	Operation recirculation	processes in a reservoir, autotrophic and heterotrophic								
	installations	nutrition, the influence of external factors on the rate								
		and volume of productivity, anthropogenic impact on								
		biotopes, methods of improving the ecological situation				<b>X</b> 7				
		in the reservoir.				V				
		Operation recirculation installations. The discipline								
		studies the structure scheme of the components of a								
		RAS, the features of the structure of a biological,								
		from the destination								
1.4	Uridro ab amiatrix /	Irom the destination.	1		V				V	
14	Microbiology and	composition of natural waters and the laws of its change	4		v				v	
	Virology	depending on the chemical physical and biological								
	vitology	processes occurring in the environment Knowledge of								
		the chemical composition of water (determining its								
		quality) is necessary for such areas of practice as water								
		supply, irrigation, fisheries; hydrochemical information								
		is important for assessing the corrosion of building								
		materials (concrete, metals), for the characteristics of								
		mineral waters, in the search for minerals (oil, ore								

		deposits, radioactive substances), etc. The study of the chemical composition of water is of great importance in the fight against pollution of water bodies <i>Microbiology and Virology</i> . Basic information about the place of prokaryotes and eukaryotes among living organisms, about the morphology, physiology and genetics of microorganisms, as well as about metabolism in a microbial cell. General characteristics of viruses. The use of microorganisms and their metabolites in the food industry. The influence of external factors on microorganisms. Mechanisms of metabolism in microorganisms. Conversion of nitrogen compounds by microorganisms.				V				
15	Structure and taxonomy of coastal plants / Meteorology	Structure and taxonomy of coastal plants. The discipline studies the external and internal structure of vegetative and generative organs of aquatic and coastal plant species, the main systematic groups of plants of water basins. Meteorology. Instruments for meteorological observations, methods, characteristics and assessments of climate and weather conditions of the growing season. Types and forms of meteorological information, their use in forestry to adjust the elements of technology for the care of tree and shrub species. The use of agroclimatic and agrometeorological information for programming in forestry.	5		V					
16	Protection of water bioresources/ Basics of legislation in fishery	The discipline studies measures for the protection of aquatic biological resources, species of aquatic organisms listed in the Red Book, and factors influencing the abundance of aquatic biological resources. Fundamentals of legislation in fisheries discipline studies the legislative framework used in fisheries; measures for the protection of aquatic biological resources; to combat poaching.	5				V V	V		

17	Fundamentals of research in fisheries/ Lake commercial fish farm	The discipline studies the goals and objectives of scientific research, the methodology of hydrobiological, hydrochemical, ichthyological research. The discipline studies the fishery use of reservoirs, by completely or partially replacing the ichthyofauna in them by catching economically low-value fish, settling, growing and subsequent catching of valuable fish species in them.	5		V		V V				
18	Technology for processing of fish products/ Whitefish cultivation	The discipline studies techniques and methods of obtaining, processing raw materials, semi-finished products carried out in various industries. The discipline studies the factory production of whitefish offspring, as well as the cultivation of high- quality planting material. Study of fish feeding standards.	5		V			V V	V	V	
19	Ecology and life safety/ Labor protection and basics of life safety	Ecology and life safety studies the laws of the existence, formation and functioning of biological systems at all levels – from the body to the biosphere and their interaction with the environment. The discipline contributes to the formation of students' knowledge, practical skills to create safe and harmless living conditions, to prevent the causes and prevention of dangerous situations, to protect the population and production personnel and objects of the national economy from the possible consequences of emergency situations. It also studies the peculiarities of labor protection for women and youth, supervision and control of the implementation of labor protection legislation and responsibility for violation of labor protection requirements.	4			VV					
20	Breeding of decorative fishes/ Sanitary hydrobiology	The discipline studies the prospects of using aquariums as an applied branch of fisheries and technologies for growing ornamental fish species. The discipline studies the pollution of reservoirs, periodic mapping of water quality by physico-chemical	5		V						V

		and biological characteristics, studies of the ecology of										
		aquatic organisms in clean reservoirs, studies of the										
		physiology and ecology of aquatic organisms, their				V						V
		changes under the influence of toxicants and										
		wastewater.										
21	Mariculture /	The discipline studies the breeding and commercial	5							V		V
	Toxicology of	cultivation of seaweed, invertebrates, fish under										
	reservoirs	controlled conditions, including changing										
		environmental parameters in order to create favorable										
		conditions for cultivated habitat organisms.										
		The discipline studies the toxicity of the aquatic								V		V
		environment, the patterns of reactions of aquatic										
		organisms of different systematic positions and										
		different levels of organization to the toxic effects of the										
		aquatic environment.										
22	Particular Ichthyology	The discipline considers the taxonomic characteristics	5		V	V						
	/	of the ichthyofauna, evaluates the external development										
	Aquatic Ecosystem	and structure of fish, features of biology and ecology of										
		various representatives of the order of fish and										
		determines their species. Studies their species										
		characteristics, biology, phylogeny, taxonomic position,										
		taxonomy, economic significance and role in nature.					V					
		The discipline studies the ecosystem of the aquatic										
		environment in which communities of organisms that										
		depend on each other live.										
		Cycle of profession	require	ments								
		University con	iponent	t	1	1	1	1	1	1		
23	Feed and feeding of	The discipline studies the concept of feed resources and	5			V		V				
	fish in aquaculture	the feed base of the reservoir, compound feed for fish										
		and their characteristics, the composition and nutritional										
		value of feed used for the production of compound										
		feeds, live feed breeding, the development of feed										
		recipes for various species of fish and aquatic										
		organisms, technological methods of rational feeding of										
		tish, ensuring their normal growth and development.			1		1					

24	Aquiculture	The discipline studies artificial breeding of freshwater	5					V		V	V		
		reservoirs, reclamation measures in fish farms.											
25	Industrial fish farming	The discipline studies the breeding and rearing of fish in	6						V		V	V	
		special fish-breeding tanks (pools, cages, circulating											
		water supply systems, closed water supply installations)											
26	Fisham dasian	with intensive feeding and planting density.	1								V	V	
20	rishery design	ne discipline studies calculations and operations that play a crucial role in the subsequent construction work	4								v	v	
27	Fisherv hydraulic	The discipline studies the design and operation of	4								V	V	
	engineering	hydraulic structures, design methods and techniques of									-	-	
	•	their construction.											
28	Fishing	The discipline studies the history of fishing	5							V	V		
		development, classification of industrial fishing gear,											
		selectivity of fishing gear, net materials and											
		construction of fishing gear, storage and assessment of											
		the condition of fishing gear, organization of fishing in											
20	Theory of formation of	Inland waters.	5					V			V		
29	fish stocks	fish stock formation factors affecting the formation of	5					v			v		
	11511 StOCK5	fish stocks food relations fertility old age and growth											
		general and natural mortality natterns of predator											
		impact on the population the influence of abiotic											
		conditions on fish mortality, causes of fluctuations in											
		fish numbers, methods of accounting for fish numbers.											
30	Technology of	The discipline studies the production of sexual products	5					V		V	V		
	cultivation of	by the factory method in fish and cultivation to											
	hydrobionts	marketable weight in commercial fish farms, with the											
		use of artificial balanced feeds.											
31	Ichthypathology	The discipline studies infectious, invasive, non-	5					V			V		
		communicable diseases of fish and their treatment and											
		prevention.	•										
Cycle of profession requirements													
	Electives component												

32	Piscine fish breeding/ Trout breeding	<i>Piscine fish breeding.</i> The discipline studies the breeding and rearing of fish in ponds, types and categories of ponds, reclamation activities in pond farms. <i>Trout breeding.</i> The discipline studies methods of obtaining sexual products and further commercial cultivation of trout using artificial feeding.	5				V V	V V	V	
33	Artificial reproduction of fishes/ Sturgeon culture	<i>Artificial reproduction of fishes.</i> The discipline studies the artificial reproduction of fish, the rearing of juveniles to the resilient stages of development and its release into reservoirs of fishery importance. <i>Sturgeon culture.</i> The discipline studies the technology of growing sturgeon fish in ponds, RAS, cages, obtaining resilient juveniles, feeding fish groups of different ages.	6				V V	V V		