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Evaluation of the state of industrial water bioresources in fish areas of Ukraine

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Contents

Abstract

Agriculture, fisheries, and the food industry play a key role in ensuring the country's food security. The modern fishing industry in Ukraine is a highly industrial, capital-intensive, integrated production with high production costs, which is designed to ensure the socio-economic development of many coastal regions and provide the population with valuable protein products necessary for healthy eating. The total volume of extracted aquatic organisms in III and IV zones of aquaculture of Ukraine was studied; dynamics of catches of aquatic organisms by regions and fishery zones on the territory of Ukraine; the structure of fishing by regions in the inland waters of Ukraine is analyzed; the leading representatives of catches in inland waters of Ukraine by regions were identified. Considering the dynamics of catches of aquatic organisms in inland waters from 2005 to 2020, it was found that production decreased significantly in almost all Ukraine regions and some regions decreased to almost zero. Studies have shown that the total production of aquatic bioresources in 2005 amounted to 42.364 tons, in 2010 – 37.615 tons, in 2015 – 35.985 tons, in 2020 – 22.267 tons. In all periods, leaders among the production in inland waters are Odesa and Cherkasy regions. Comparing the data for 2005 and 2020, it can be seen that catches have almost halved. It is established that, according to the analysis, the main representatives of the caught ichthyofauna are: grass carp, carp, crucian, bream, silver carp, ram, pike perch, pike, perch, catfish. The structure of catches for the whole period remains almost unchanged. The largest catches (2019) are: carp – 1704 tons; silver carp – 675 tons Sumy region; crucian carp – 398.8 tons; ram (flat) – 364.5 tons Kyiv region. The main species found in the catches of other regions are – the Volyn region – carp (237 tons), Zhytomyr region – silver carp (300 t), Lviv region – carp (499 tons), Rivne region – carp (134 tons), Ternopil region – carp (342.4 tons), Khmelnytsky region – carp (279.2 tons), Chernihiv region. – carp (352.8 t). Pike, grass carp, and catfish were the least caught in the whole territory of Ukraine. It should be noted that several factors that affect fish stocks of inland waters, and consequently catches, most often consider the impact of environmental factors, destruction and inefficiency of spawning grounds, age and sex structure of populations, poaching, etc.

Keywords: catch, aquaculture, fishing, ichthyofauna, fish zones, catch structure.

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1. Introduction

Fisheries, as a whole, play a significant role in Ukraine's economy. It includes fishing and processing, reproduction and protection of fish stocks, breeding and rearing of marketable fish, breeding and research work, research and development, sectoral multilevel training system, etc. (Hrytsyniak & Gurbyk, 2017; Senechyn, 2020; Kofonov et al., 2020; Honcharova et al., 2021).

Inland fishing and aquaculture account for about 25 % of world fish production. In addition, many essential fisheries in estuaries and coastal waters are closely linked to environmental processes occurring in freshwater systems. The central part of production is created due to small-scale activities with an extremely high level of participation in fishing, processing, and marketing. Inland fishing is often crucial for local food security (Rybne hospodarstvo Ukrainy; Stan rybnoho hospodarstva).

According to the temperature regime, the territory of Ukraine is usually included in four zones of pond fish farming. The division into zones is based on the number of days when the air temperature exceeds 15 °C. Modern pond farms are divided into warm-water carp and cold-water trout. The main object of cultivation in hot water farms until the 60ies was carp, which received from 90 to 100 % of all products from feeding ponds. During this period, tench, silver carp, rainbow trout, pellets, sterlet, and other fish species were used as additional fish, which slightly increased total fish production. To free the feeding ponds from garbage fish, they planted predatory fish – pike and pike perch. Compared to carp, additional fish had a low growth rate, a slight increase in fish production, higher environmental requirements, and competed in nutrition with carp. This has led to the complete abandonment of the use of these fish species in commercial pond fisheries (Rybne hospodarstvo Ukrainy; Kapustynska, 2019).

Since the 1960ies, fish from the Far Eastern complex, the so-called herbivorous fish: white and variegated silver carp and their hybrids and grass carp, have been grown in ponds together with carp. These fish, like carp, have a fast growth rate, are resistant to adverse environmental conditions, winter well enough, and almost do not compete with carp in nutrition. There is a stable community of fast-growing and compatible with carp fish species in pond fish farming, i.e., polyculture of carp with herbivorous fish.

The peculiarity of the hot-water pond carp farm is that the fish are raised in artificial ponds. These are often dug and compacted floodplain ponds, with a relatively small area (from 0.1 to 100 ... 200 ha) and an average depth (not more than 1.3 ... 1.5 m). Ponds are entirely drained in the absence of flow and intensive feeding of carp.

Another type of pond farm – is a cold-water pond farm. The objects of breeding in them are brook trout, rainbow trout, Sevan trout, Donaldson trout, steel-headed salmon, and others. In contrast to carp fish, these fish are more demanding oxygen content in the water, freshwater, and complete high-protein food (Rybne hospodarstvo Ukrainy; Stan rybnoho hospodarstva).

Ponds in cold-water salmon farms are small, with an area of 100 to 1000 m^2 with an average depth of 1.5 m. The soil should be gravel-sandy and pebble. The ratio of the parties in the pond is 1: 5, 1:10, and even up to 1:20. The ponds are quickly filled with water and emptied. Discharge of water takes 1 ... 4 hours.

The **purpose of the study** was to assess the current state of the fishery for aquatic bioresources and to study the structure of fish catches in the regions and fish-breeding zones of Ukraine.

2. Materials and methods

Based on specialized literature, the current state of aquatic bioresources in general and inland water bodies in III and IV fish-growing zones of Ukraine is assessed, the dynamics of aquatic life catches by regions and fishery zones in Ukraine is studied Of Ukraine in the period 2000–2019. All data used for the analysis were statistically processed.

3. Results and discussion

The territory of Ukraine belongs to four fish-growing zones, namely Zone III – Polissya, Zone IV – Forest-Steppe and Prykarpattia, Zone V – Northern Steppe, and Zone VI – Southern Steppe (Fig. 1).

Fig. 1. Pond aquaculture zones of Ukraine

The aquaculture zone of Polissya (III zone) includes nine oblasts, namely: Volyn, Zhytomyr, Lviv, Rivne, Sumy, Ternopil, Khmelnytsky, Chernihiv, the northern part of Kyiv oblast.

The forest-steppe zone of the Forest-Steppe and Prykarpattia (Zone IV) includes eight oblasts, such as Vinnytsia, Poltava, Kharkiv, Cherkasy, Zakarpattia, Ivano-Frankivsk, Chernivtsi, the southern part of Kyiv.

Northern Steppe Aquaculture Zone (Zone V) includes the following regions: Dnipropetrovsk, Donetsk, Zaporizhia (northern part). Kirovohrad, Lugansk.

The zone of aquaculture Southern Steppe (VI zone) includes Zaporizhzhia (southern part), Mykolaiv, Odesa, Kherson, Crimea.

Considering the dynamics of catches of aquatic organisms in inland waters from 2005 to 2020 (Dobuvannia vodnykh bioresursiv za rehionamy; Kapustynska, 2019) (Table 1), it should be noted that production decreased significantly in almost all Ukraine regions, and some regions decreased to almost zero.

Table 1

Catch of aquatic organisms in inland waters by fishing regions 2005–2020, tons (According to the State Statistics of Ukraine) (Derzhavna sluzhba statistiki Ukrayini)

Region of industry	2005	2010	2015	2020
Vinnytsia	1691	1926	2037	195.8
Volyn	664	423	772	–
Dnipropetrovsk	1580	1794	2035	3448.3
Donetsk	1986	3062	2107	1648.5
Zhytomyr	875	534	609	к
Zakarpattia	422	377	402	к
Zaporizhzhia	2684	2202	1401	1069,8
Ivano-Frankivsk	603	507	610	69.3
Kyiv	2261	1999	…[3]	2303,2
Kirovohrad	1291	1553	1832	523,3
Luhansk	511	513	…[3]	134.1
Lviv	1626	1287	809	52.5
Mykolayiv	3258	2483	1708	493.2
Odesa	6659	4344	5077	3923.2
Poltava	3459	1379	1113	1264.6
Rivne	713	486	520	–
Sumy	1681	2112	2534	–
Ternopil	515	745	239	–
Kharkiv	1010	1107	1248	437.4
Kherson	1959	1717	2461	1795.2
Khmelnytsky	824	176	479	508.1
Cherkasy	4568	5254	5856	4325.7
Chernivtsi	366	487	1081	–
Chernihiv	1158	1148	1055	74.4

Thus, the total production of aquatic bioresources in 2005 amounted to 42.364 tons, in 2010 – 37.615 tons, in 2015 – 35.985 tons, in 2020 – 22.267 tons. The leaders among the production in inland waters in all periods are Odesa and Cherkasy regions. Comparing the data for 2005 and 2020, it can be seen that catches have almost halved.

All this has specific reasons. The first, one of the main reasons, is environmental, as all water bodies receive chemical fertilizers from fields and leach into industrial wastewater from enterprises, cities, etc. Another reason is the barbaric poaching of our fish resources when fishing with trawls (Burgaz et al., 2019; Burhaz et al., 2021).

Considering the structure of fish catches by regions of Ukraine is given in table. 2 and table. Three, it should be noted that the prominent representatives of the ichthyofauna caught include: grass carp, carp, crucian, bream, silver carp, ram, zander, pike, perch, catfish (Kapustynska, 2019; Burgaz et al., 2019).

Analyzing the structure of catches in 2015, it should be noted that the main species harvested for this region were - carp (1704 tons) and silver carp (703 tons) Sumy region.

Table 2

The structure of fishing by region in the inland waters of Ukraine in 2015, t (according to the State Statistics Service of Ukraine) (Derzhavna sluzhba statistiki Ukrayini)

Region of industry	Grass carp	Carp	Crucian	Bream	Silver carp	Ram	Zander	Pike	Perch	Catfish
Vinnytsia	15	580	307	14	1024	25	10	19	6	2
Volyn	22	311	84	1	173	1	…[1]	13	2	…[1]
Dnipropetrovsk	12	187	609	267	343	272	44	2	22	22
Donetsk	3	670	57	5	1342	13	3	3	7	…[1]
Zhytomyr	…[1]	197	45	–	248	…[1]	…[1]	…[1]	…[1]	–
Zakarpatska	…[1]	266	…[1]	–	103	–	–	…[1]	–	…[1]
Zaporizhzhia	3	41	608	113	281	271	44	…[1]	4	28
Ivano-Frankivsk	35	465	…[1]	–	83	–	–	1	–	–
Kyiv	…[1]	270	221	224	480	329	106	47	61	40
Kirovohrad	25	417	112	336	455	230	99	10	…[1]	28
Luhansk	…[1]	…[1]	…[1]	…[1]	…[1]	–	…[1]	…[1]	…[1]	–
Lviv	13	570	19	–	126	–	–	8	…[1]	…[1]
Mykolayiv	33	127	104	43	396	26	…[1]	…[1]	…[1]	1
Odesa	55	338	1442	280	1967	42	…[1]	19	38	8
Poltava	2	36	307	341	70	180	24	6	25	10
Rivne	8	352	…[1]	–	131	…[1]	–	…[1]	…[1]	–
Sumy	…[1]	1704	90	–	703	–	…[1]	…[1]	–	3
Ternopil	7	164	10	–	48	–	–	9	…[1]	–
Kharkiv	21	220	36	39	793	4	5	4	5	40
Kherson	44	269	790	88	668	83	174	6	…[1]	8
Khmelnytsky	…[1]	292	59	…[1]	59	8	…[1]	10	…[1]	…[1]
Cherkasy	66	1089	208	1155	1373	894	98	46	44	87
Chernivtsi	4	569	62	…[1]	312	…[1]	…[1]	…[1]	…[1]	…[1]
Chernihiv	45	609	94	…[1]	162	…[1]	…[1]	44	4	9

Table 3

The structure of fish caught by region in the inland waters of Ukraine in 2019, t (according to the State Statistics Service of Ukraine) (Derzhavna sluzhba statistiki Ukrayini)

Region of industry	Grass carp	Carp	Crucian	Bream	Silver carp	Ram	Zander	Pike	Perch	Catfish
Vinnytsia	10.0	580	305.6	11.3	987.0	19.7	7.0	10.3	2.7	7.4
Volyn	17.4	311	63.8	1.9	90.8	1.8	0.4	8.4	4.2	1.7
Dnipropetrovsk	46.9	187	1883.4	345.1	403.2	363.1	60.7	19.4	80.4	45.5
Donetsk	26.5	670	60.3	2.6	1223.4	2.6	4.0	4.2	7.8	k
Zhytomyr	5.3	197	55.3	0.0	300.0	1.0	k	17.6	27.2	k
Zakarpatska	k	266	k	–	47.9	–	–	k	–	k
Zaporizhzhia	2.1	41	559.9	107.5	72.9	232.1	40.6	0.9	5.1	13.3
Ivano-Frankivsk	14.9	465	6,1	k	91.7	0.1	k	k	0.1	–
Kyiv	31.1	270	398.8	251.1	469.2	364.5	213.0	57.0	89.3	65.7
Kirovohrad	12.0	417	191.6	134.4	372.8	116.5	21.0	6.4	16.5	24.1
Luhansk	k	…[1]	4.0	0.7	73.2	0.0	0.2	1.1	1.2	–
Lviv	6.1	570	31.1	k	122.4	1.3	0.5	5.9	1.8	–
Mykolayiv	42.0	127	172.7	57.1	279.5	42.1	11.1	4.0	4.8	1.1
Odesa	k	338	3059.5	320.6	894.0	57.2	373.3	k	k	14.3
Poltava	k	36	366.7	376.5	31.0	182.7	50.7	18.5	81.5	16.3
Rivne	17.8	352	26.5	–	61.7	4.7	0.3	3.2	5.5	k
Sumy	52.6	1704	114.0	–	675.0	–	k	k	–	2.8
Ternopil	k	164	k	–	50.6	–	–	9.8	к	–
Kharkiv	34.9	220	58.1	32.7	532.6	3.5	7.5	7.2	7.2	3.1
Kherson	54.0	269	657.0	94.2	708.0	86.6	27.3	6.1	8.9	12.1
Khmelnytsky	3.6	292	49.8	0.7	244.6	1.6	0.4	к	к	0.3
Cherkasy	52.0	1089	578.7	1253.9	1072.0	975.8	176.1	43.6	97.6	52.7
Chernivtsi	23.9	569	80.7	–	146.9	–	–	2.0	0.9	–
Chernihiv	19.4	609	45.2	24.0	103.0	11.5	1.0	11.3	1.4	2.3

The main species caught in the regions of this region were: the Volyn region – carp (311 tons), Zhytomyr region – silver carp (248 t), Lviv region – carp (570 tons), Rivne region – carp (352 tons), Ternopil region – carp (164 tons), Khmelnytsky region – carp (292 tons), Chernihiv region – carp (609 t). Bream, pike perch, perch, and catfish were the least caught.

The largest catches (2019) in this region are: carp – 1704 tons; silver carp – 675 tons Sumy region; crucian carp – 398.8 tons; ram (flat) – 364.5 tons Kyiv region.

The main species found in the catches of other regions are – the Volyn region – carp (237 tons), Zhytomyr region – silver carp (300 t), Lviv region – carp (499 tons), Rivne region – carp (134 tons), Ternopil region – carp (342.4 tons), Khmelnytsky region – carp (279.2 tons), Chernihiv region – carp (352.8 t).

Pike, grass carp, and catfish were the least observed in the catches of this region.

Considering the catch, in the inland waters for 2010–2019, in the III fish-breeding zone on the territory of Ukraine, the following results were obtained (Fig. 2). The leaders of 2010 were Kyiv, Sumy, Lviv, and Chernivtsi regions.

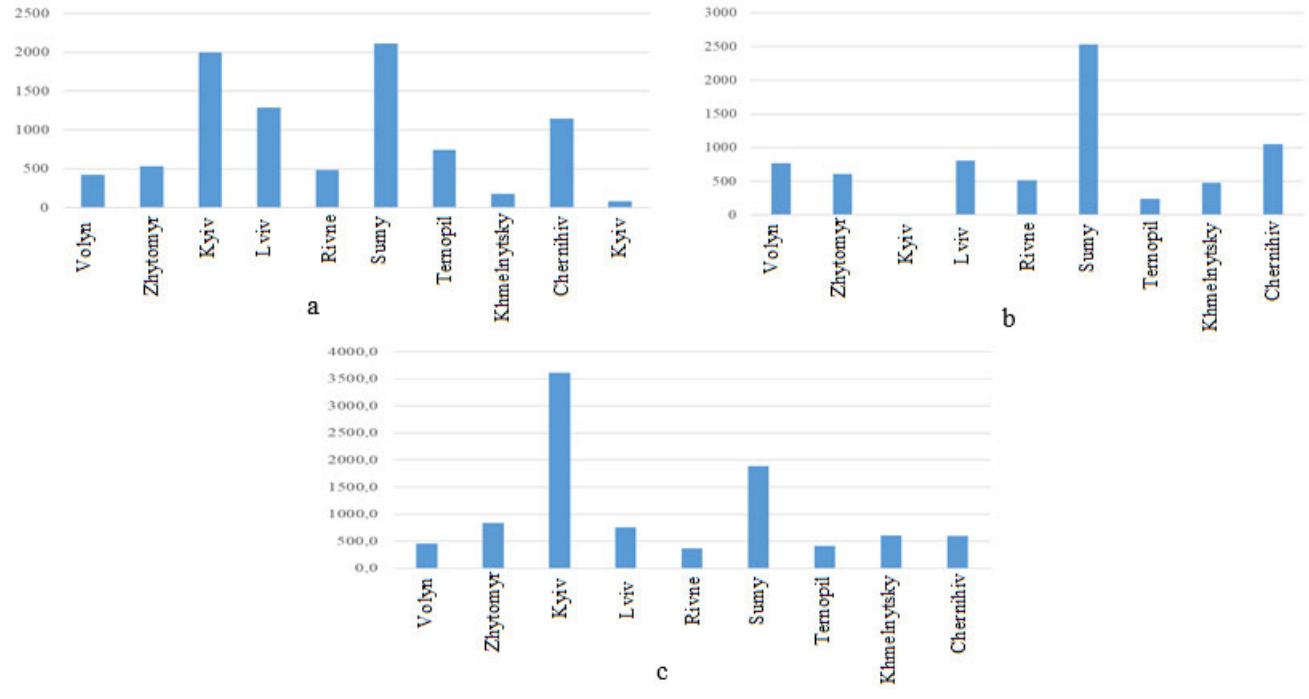

Fig. 2. Dynamics of catching aquatic organisms in inland waters, tons
a – 2010, b – 2015, c – 2019

The catch in them was 1999 tons, 2112 tons, 745 tons, and 1148 tons, respectively. In the 2015 – Sumy and Chernivtsi regions, the catch was 2534 tons and 1055 tons, and in the 2019 – Kyiv and Sumy regions, the catch was 3614.2 tons and 1887, in tons, respectively.

The total volume of extracted aquatic organisms in 2019 was 12,282 tons, which is almost 14 % of the total volume of extracted aquatic organisms throughout Ukraine, of which aquaculture is 4448.7 tons, and catch from inland water bodies – 3327.1 t. In table 4 and fig. 3 presents the extraction of aquatic organisms as aquaculture and inland water bodies in 2019.

Table 4

Total volume of harvested aquatic organisms in the III zone of aquaculture of Ukraine in 2019, t (according to the State Statistics of Ukraine) (Derzhavna sluzhba statistiki Ukrayini)

	All regions of industry	Out of the total volume extracted by regions of fishing				
		aquaculture	Internal water objects	Region of the Azov sea	Region of the Black sea	Antarctic part of the Atlantic
Volyn	455.2	455.2	–	–	–	–
Zhytomyr	841.4	k	k	–	–	–
Kyiv	3614.2	k	2303.2	k	–	–
Lviv	755.3	702.8	52.5	–	–	–
Rivne	367.4	367.4	–	–	–	–
Sumy	1887.7	1887.7	–	–	–	–
Ternopil	411.9	411.9	–	–	–	–
Khmelnytsky	607.3	99.2	508.1	–	–	–
Chernihiv	598.9	524.5	74.4	–	–	–
Kyiv	3289.0	–	388.9	k	к	–
In general	**12828.3**	**4448.7**	**3327.1**			
Ukraine*	**92682.0**	**12675.4**	**22928.7**	**15082.9**	**k**	**k**

* The data are given without taking into account the temporarily occupied territory of the Autonomous Republic of Crimea;
Symbol (k) – data are not published in order to ensure compliance with the requirements of the Law of Ukraine "On State Statistics" on confidentiality

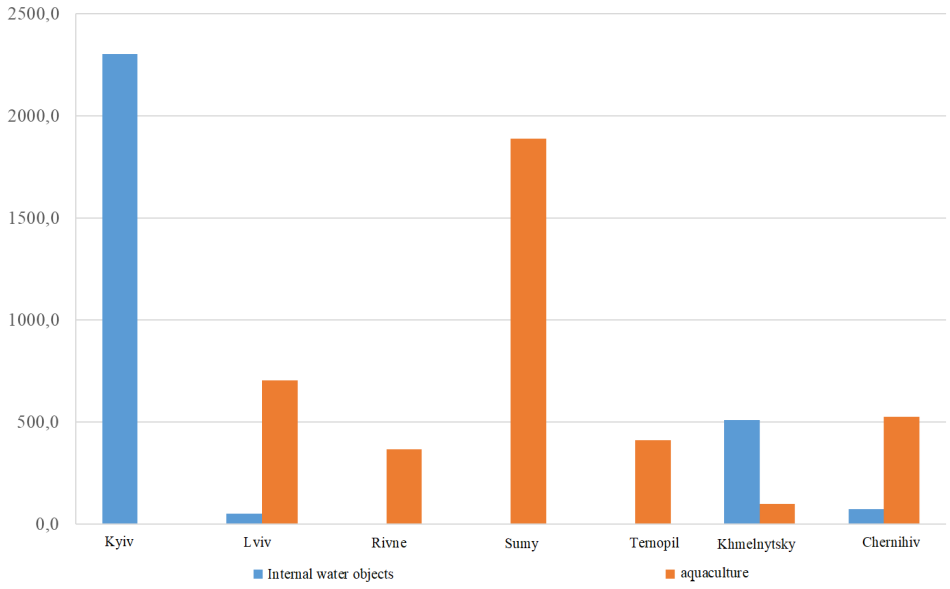

Fig. 3. Extraction of aquatic organisms in inland water bodies and aquaculture of the III fish-water zone for the territory of Ukraine

As can be seen from Fig. 3. The aquaculture leader in the Sumy region, where 1887.7 tons of aquatic organisms were extracted, and the leader in catching inland aquatic objects is the Kyiv region, where 2303.2 tons of aquatic organisms were extracted. However, there are some areas where data are not disclosed to ensure compliance with the Law of Ukraine "On State Statistics" on the confidentiality of statistical information.

While analyzing the structure of catches of the third fish zone for 2015–2019. It should be noted that in 2015 the main species that were harvested for this region were – carp (1704 tons) and silver carp (703 tons) Sumy region.

The main species caught in the regions of this region were: the Volyn region – carp (311 tons), Zhytomyr region – silver carp (248 t), Lviv region – carp (570 tons), Rivne region – carp (352 tons), Ternopil region – carp (164 tons), Khmelnytsky region – carp (292 tons), Chernihiv region – carp (609 t). Bream, pike perch, perch, and catfish were the least caught.

The largest catches (2019) in this region are: carp – 1704 tons; silver carp – 675 tons Sumy region; crucian carp – 398.8 tons; ram (flat) – 364.5 tons Kyiv region.

The main species found in the catches of other regions are – the Volyn region – carp (237 tons), Zhytomyr region –

silver carp (300 t), Lviv region – carp (499 tons), Rivne region – carp (134 tons), Ternopil region – carp (342.4 tons), Khmelnytsky region – carp (279.2 tons), Chernihiv region – carp (352.8 t).

Pike, grass carp, and catfish were the least observed in the catches of this region.

As can be seen from the table 3 in 2019. The third fish-growing zone for the territory of Ukraine preferred the cultivation of carp and silver carp, the least growing and catching pike, catfish, pike perch.

The aquaculture zone of the Forest-Steppe and Prykarpattia (zone IV) includes eight oblasts, and the total volume of extracted aquatic organisms by region is shown in Fig. 4.

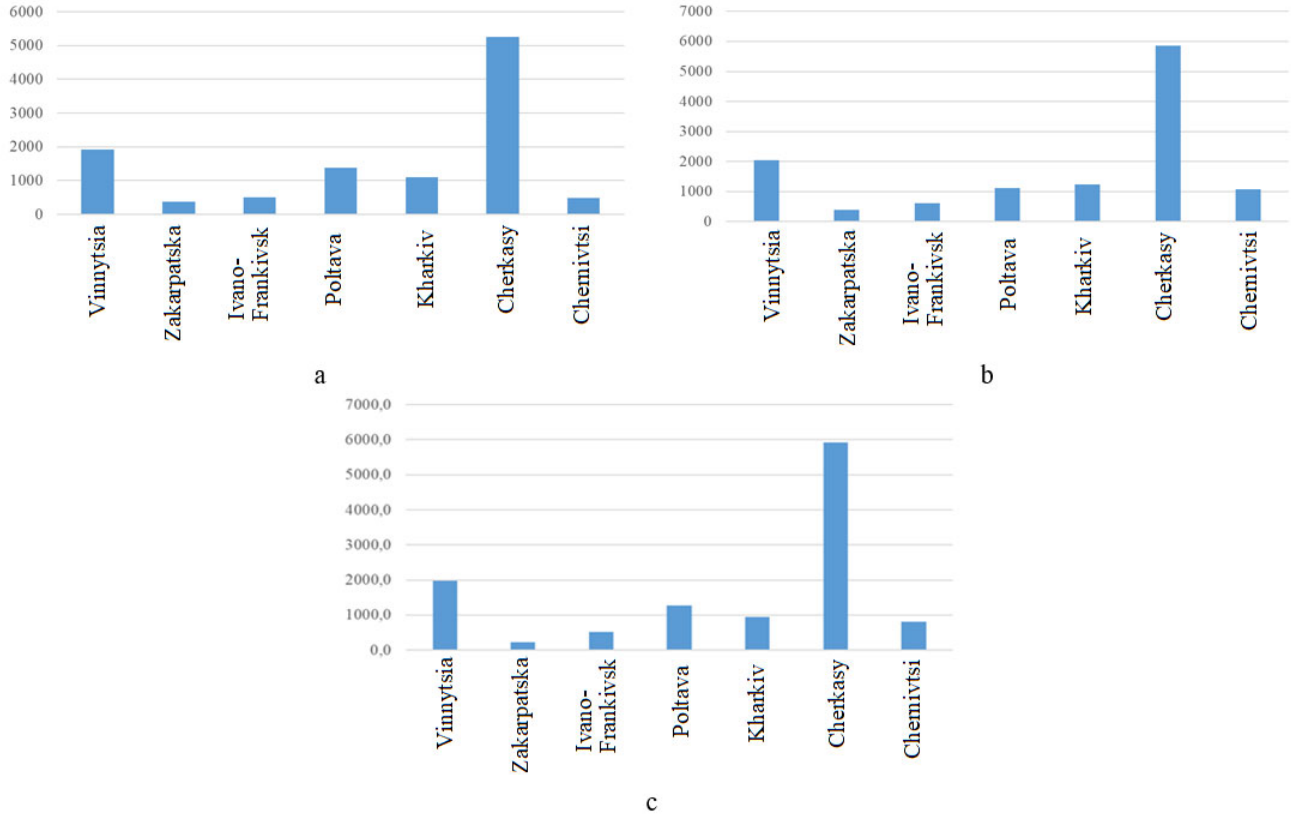

Fig. 4. Dynamics of catching aquatic organisms in inland waters, tons
a – 2010, b – 2015, c – 2019

Considering the catch in inland waters for 2010–2019, we obtained the following results (Fig. 4): the leaders of 2010 are Cherkasy and Vinnytsia regions. The catch in them was 5254 tons and 1926 tons, respectively.

In 2015, the maximum catch was presented in the same areas of the fish zone and amounted to 5856 tons and 2037 tons, and in 2019 – the constant leaders in catching aquatic organisms of this fish zone (Cherkasy and Vinnytsia regions) joined the Poltava region, whose catch was 5914.0 tons, 1975.9 tons and 1278.8 tons, respectively.

The total catch of aquatic organisms in 2019 (Table 5) is 11,675.7 tons, which is 12 % of the total catch in Ukraine, of which aquaculture is 5154.7 tons, and catch from inland water bodies – 6292.8 tons (Fig. 5).

Table 5
Total volume of harvested aquatic organisms in the IV zone of aquaculture of Ukraine in 2019, t (according to the State Statistics of Ukraine) (Derzhavna sluzhba statistiki Ukrayini)

	All regions of industry	Out of the total volume extracted by regions of fishing				
		Aquaculture	Internal water objects	Region of the Azov sea	Region of the Black sea	Antarctic part of the Atlantic
Vinnytsia	1975.9	1780.1	195.8	–	–	–
Zakarpatska	228.2	k	k	–	–	–
Ivano-Frankivsk	516.7	447.4	69.3	–	–	–
Poltava	1278.8	14.2	1264.6	–	–	–
Kharkiv	953.6	516.2	437.4	–	–	–
Cherkasy	5914.0	1588.3	4325.7	–	–	–
Chernivtsi	808.5	808.5	–	–	–	–
In general	**11675.7**	**5154.7**	**6292.8**			
Ukraine*	**92682.0**	**12675.4**	**22928.7**	**15082.9**	k	k

* The data are given without taking into account the temporarily occupied territory of the Autonomous Republic of Crimea;
Symbol (k) – data are not published in order to ensure compliance with the requirements of the Law of Ukraine "On State Statistics" on confidentiality

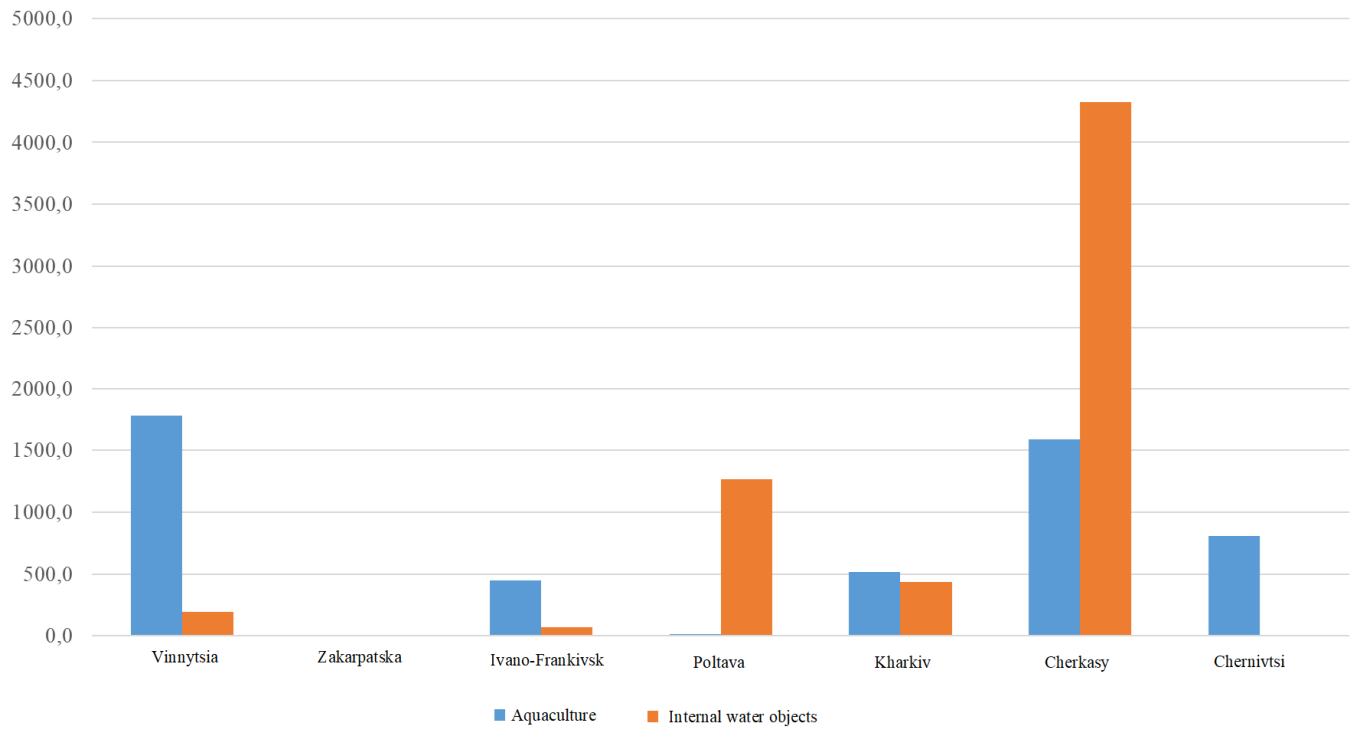

Fig. 5. Extraction of aquatic organisms in inland water bodies and aquaculture of the IV fish-water zone for the territory of Ukraine, tons

As shown from Fig. 5, Vinnytsia and Cherkasy oblasts belong to the oblasts with the maximum development of aquaculture of this fish-growing zone, the catch of aquatic organisms amounted to 1780.1 tons 1588.3 tons, respectively. Furthermore, the leader in the extraction of aquatic bioresources in inland water bodies was the Cherkasy region – 4325.7 tons.

There are also some areas in this fish farming area where data are not published to ensure compliance with the requirements of the Law of Ukraine "On State Statistics" on the confidentiality of statistical information.

Considering the structure of catches (Dobuvannia vodnykh bioresursiv za rehionamy; Kapustynska, 2019), it should be noted that the leading industrial species in the Vinnytsia region in 2015 and 2019 was silver carp. The numerous minor species were in 2015 catfish and 2019 perch.

Zakarpattia, Ivano-Frankivsk, and Chernivtsi regions (2015) partially do not disclose catches to ensure compliance with the Law of Ukraine "On State Statistics" on confidentiality of information. However, according to published data, it can be noted that the main catches are carp, silver carp, and crucian.

Poltava region (2015) in the leaders of bream, crucian carp and ram (flatworm), Kharkiv and Cherkasy regions – carp, silver carp, crucian carp.

In the structure of catches in 2019 of this fish zone, it was noted that the maximum catch is bream – 1253.9 tons, carp – 1089 tons, silver carp – 1072 tons, and ram – 975.8 tons (Cherkasy region). In other regions, the maximum became: the Vinnytsia region. – carp (987 tons), Zakarpattia – carp (152.3 tons), Ivano-Frankivsk – carp (367.4 tons), Poltava – bream (376.5 tons), Kharkiv – carp (532.6), Chernivtsi – carp (446.3 t).

Pike, perch, pike perch, and catfish are the least represented in the catch structure of all regions.

4. Conclusions

Several factors hinder the development of the industry. Their whole set can be conditionally divided into several aggregated groups:

1) production and economic factors, which include the shortage of quality domestic fish material, shortage of Ukrainian feed, import dependence on equipment; depreciation of fixed assets of fisheries enterprises; low manufacturability of productions; predominance of small farms; problems with access to financial resources; lack of qualified personnel with specialized education; intensification of competition in the world fish market;

2) marketing and organizational factors: insufficient focus on market demand and needs, uncompetitive price, underdeveloped logistics, barriers to entry into trade networks, weak development of market infrastructure, higher prices of products in export markets; remoteness of fish production centers from consumption centers and high cost of transportation of frozen and chilled fish;

3) problems related to state regulation: the imperfection of the control and supervision system and customs and tariff regulation of exports and imports, low efficiency of state support, unresolved legal issues in fisheries, administrative barriers, and bureaucracy.

These factors significantly affect the development of fisheries in Ukraine, which has a free capacity of the domestic market, and products are competitive due to lower costs due to the devaluation of the national currency and low labor costs.

In the world's most developed fisheries, aquaculture is recognized as one of the most important factors that improve the economy, saturate the domestic market with quality fish products, increase employment, increase exports and related revenues. In this regard, the urgency of making adjustments to the current system of organization and functioning of

domestic fisheries and implementing a set of measures to improve.

Conflict of interest

The authors declare that there is no conflict of interest.

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