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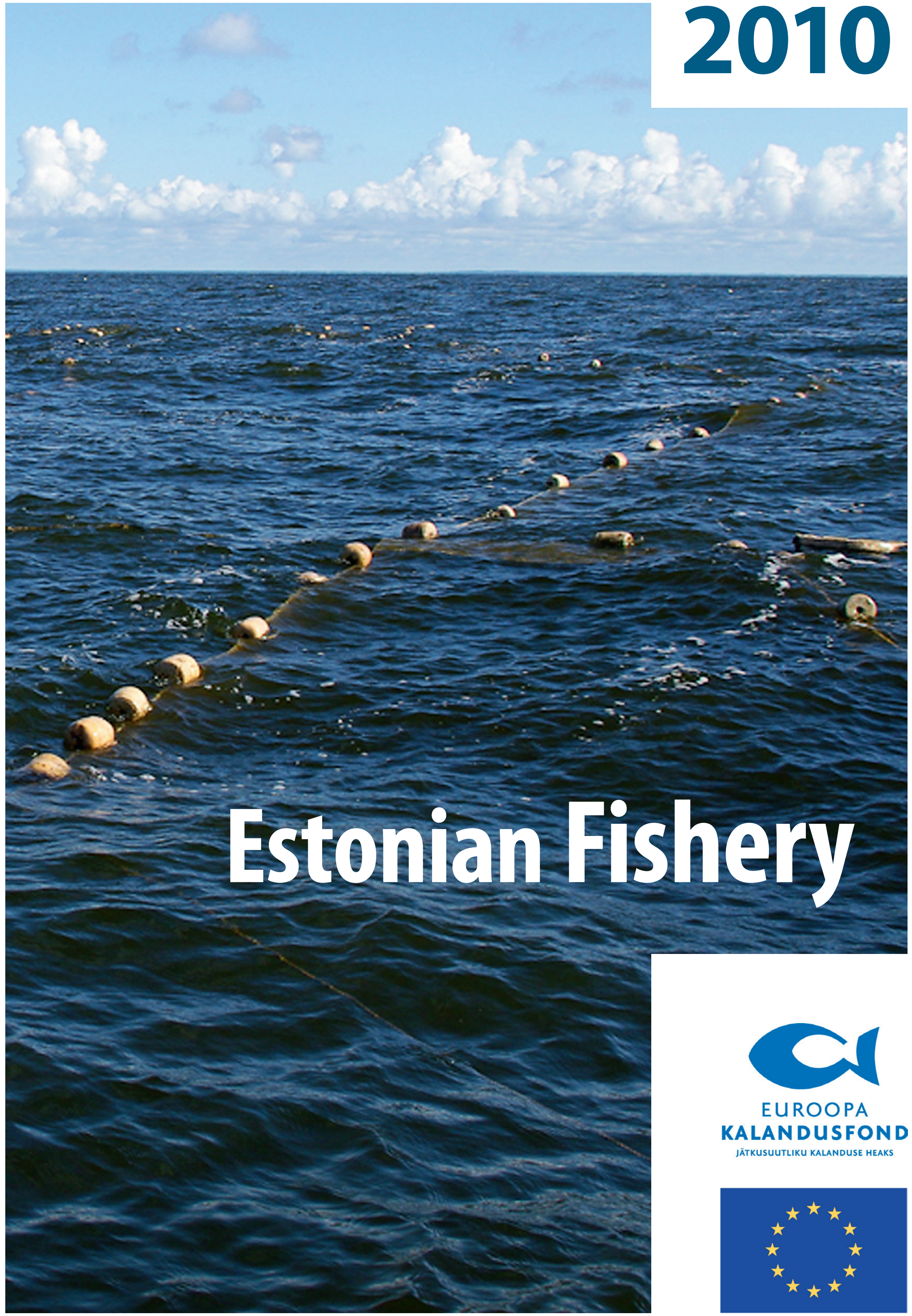

Estonian Fishery

EUROOPA
KALANDUSFOND
JÄTKUSUUTLIKU KALANDUSE HEAKS

Toetab Euroopa Liit

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Fisheries Information Centre
Pärnu 2012

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Foreword

This publication provides an overview of our fish stocks and highlights key trends in the Estonian fishery over the period 2005–2010.

In the past, the Estonian fishery was discussed in more detail in the guide *Eesti kalandus 2005* ('Estonian Fishery 2005'; Saat *et al.*) prepared by the Estonian Marine Institute at the University of Tartu, and in the publication issued by the OECD in 2009 'Estonian Fisheries and Aquaculture Sector 2009'.

Given that all of the fishing operations and most of the fish processing industry depend on our natural fish stocks, fishery has been greatly influenced by the overall decline in fish stocks, including those of the Baltic Sea, over the last decade. For example, quotas for Estonia's most important trawling target in the Baltic Sea – sprat – were reduced from 53,023 tonnes in 2007 to 43,522 tonnes in 2010. Herring quotas dropped from 34,074 tonnes to 31,007 tonnes over the same period. This trend poses a challenge to both fishermen and fish processing companies. In a situation where fish stocks cannot be expected to increase significantly in the near future and first sale prices have remained relatively stable for most fish species for many years, while the prices of a number of expenditure items (fuel, energy, labour costs etc.) are on the rise, fishermen face a choice of increasing fishing efficiency by providing added value to the catch, or giving up fishing altogether. Indeed, the number of people involved in fishing has declined remarkably over the past five years, with the number of those for whom fishing is the only source of income decreasing gradually.

Moreover, Estonian fishery as part of the economy did not remain unscathed by the economic crisis of 2008. Many companies operating in the sector went out of business; others had to reduce production capacity and seek new markets in the changed economic circumstances. Whereas in 2002 there were 91 companies in Estonia whose main business comprised processing and can of fish, crustaceans and molluscs, by 2010 the number of companies whose business was in this field had decreased to 52, and the number of employees engaged in the sector had fallen by nearly 60%.

The European Fisheries Fund (EFF) set up by the European Commission funded the Estonian fishery sector with nearly 29 million euros from 2008–2010 to facilitate adaptation to changed conditions and to make the sector more economically flexible and ecologically sustainable.

A good example of this is the creation of a local fishery network, with eight regional action groups in the network having largely contributed to the development of coastal fishery and coastal communities. In addition, three producer organisations have set up cold stores in Haapsalu, Paldiski and Audru with support from the EFF. Such EFF-supported cooperative activities enable producer organisations to ensure better quality of production, and fishermen to obtain fairer prices for their catches.

It is felt that joint activities and cooperation between various parts of the fishery sector provide an opportunity to endure in the increasingly competitive economy. To this end, coastal fishermen need to increasingly think about ancillary activities related to traditional fishing activities, be it fishing tourism or marine tourism, on-site provision of added value to catches or activities related to nature conservation.

While fishing is mainly based on natural resources and has already reached the maximum acceptable level (no increase in the exploitation rate of commercial species is anticipated in the near future), fish farming has remarkable potential for development in Estonia. Fish farming production, which has been low for many years in the country, could be multiplied with the help of new technology and support targeted at the aquaculture sector.

Distressing trends are also being observed in the consumption of fish in Estonia. According to the data of the Estonian Institute of Economic Research, nearly 71 kg of fish were caught per inhabitant in Estonia in 2010. At the same time, each inhabitant of Estonia consumed, on average, just 10.5 kg of fish and fish products, with the share of fresh fish accounting for a mere 4.3 kg. It should be noted that imported (rather than local) fish formed a large part of this modest consumption of fresh fish.

With its long maritime border and two large lakes, Estonia has always been and will clearly continue be a fishery country. The well-being of our fishery will depend on the sector as a whole, but also on the relevant agencies, research institutions and our entire community in the coming years. Sector-specific activities will mainly focus on sustainable and science-based management of dwindling fish stocks, so that Estonia can continue to be a fishing and maritime country in the long term.

Toomas Armulik
Head of Fisheries Information Centre

Abbreviations

CPUE	catch per unit effort (e.g. grams or individuals per trawling hour)
EE	Enterprise Estonia Foundation
EC	European Commission
EFF	European Fisheries Fund
EIER	Estonian Institute of Economic Research
EU	European Union
CSECC	Central Society of Estonian Consumers Co-operatives
F	fishing mortality rate
F_{MGT}	international management plan-based fishing mortality rate target level
F_{MSY}	maximum fishing mortality for sustainable yield
F_{PA}	sustainable mortality rate i.e. maximum exploitation intensity (fishing mortality precautionary approach)
GT	gross tonnage
ICES	International Council for the Exploration of the Sea
IQ	individual quota
EIC	Environmental Investment Centre
MoE	Ministry of the Environment
M	natural mortality
NAFO	Northwest Atlantic Fisheries Organisation
NEAFC	North East Atlantic Fisheries Commission
NIPAG	Joint NAFO/ICES Assessment Working Group
OECD	Organisation for Economic Co-operation and Development
MoA	Ministry of Agriculture
ARIB	Agricultural Registers and Information Board
RFMO	Regional Fisheries Management Organisation
SE	Statistics Estonia
SAPARD	Special Accession Programme for Agriculture and Rural Development
SSB	spaw stock biomass
TAC	total allowable catch
UT EMI	Estonian Marine Institute of University of Tartu
Z	total mortality

Distant-water fishery

Distant-water fishery means fishing outside of the Baltic Sea. Distant-water fishing vessels flying the Estonian flag have fishing rights on three fishing grounds: Svalbard, North West Atlantic (NAFO) and North East Atlantic (NEAFC). After Estonia acceded to the European Union, it retained fishing rights within the framework of these international organisations on the basis of the principle of relative stability and as a share of the fishing quota of the European Union (Aps *et al.*, 2005).

Fleet

Distant-water fishing fleet still consist of just trawlers on board which fish or shrimp undergo primary or final processing. As a rule, demersal trawls are used. However, pelagic trawls are occasionally used as well. A crew typically consists of around 20 people.

In 2004 there were 13 distant-water fishing vessels registered in the Fishing Vessel Register. By 2010 the number of such vessels had decreased to six. The average length of the vessels is 63 m; the average age is 31 years; the combined capacity of the vessels' main engines is 12,670 kW; and the combined gross tonnage is 8281 t (Table 1). The number of vessels actually engaged in distant-water fishery was even smaller in all years. For example, in 2010 there were five such vessels, which are owned by two companies. Vessels deleted from the register have either switched area of activity or been exported.

Table 1. Main characteristics of Estonian distant-water fishing fleet, 2005–2010

Year	Number of vessels	Combined capacity of main engines (kW)	Combined gross tonnage
2005	10	18 605	11 520
2006	11	21 413	12 923
2007	10	19 923	12 215
2008	8	15 634	10 331
2009	6	12 670	8281
2010	6	12 670	8281

Source: MoA

State of fish stocks

The state of fish stocks in the NAFO area is assessed by the Scientific Council of NAFO on the basis of exploratory trips and/or commercial fishing data.

NAFO observers on board vessels help collect data on Estonia's commercial fishing. To determine the total allowable catches (TACs), the precautionary approach has been applied in the NAFO area since 2003, which should ensure the preservation of stocks and the ecosystem. It is recommended to apply closure of commercial fishing when the biomass of stocks drops below the predetermined danger limit. Such a recommendation has been implemented several times, because many fish stocks remain low or have decreased in the NAFO area in recent years. This suggests that either the management of stocks has not been efficient or fishing mortality is not the most important factor affecting stocks. Interaction between environmental conditions and species is increasingly taken into account when assessing stocks.

A recovery plan has been established for some fish species, e.g. Greenland halibut (a 15-year plan applied since 2003) and the 3NO cod (since 2007) (NAFO, 2011). The recovery plans have not yet led to a significant increase in the stocks of these species, but as they are long-term plans, recovery can be expected in future.

Shrimp stocks have declined in the NAFO divisions 3M and 3L in recent years. In 2010 the total allowed fishing effort was reduced by 50% for NAFO 3M shrimp. For 2011, commercial fishing for shrimp was closed altogether in accordance with a recommendation of the Scientific Council, as the biomass of stocks, which had been decli since 2007, fell below the set level (B_{lim}) (NIPAG, 2010). This affected Estonian distant-water fishing vessels to a large extent, because the country has traditionally caught large quantities of shrimp in the division 3M, which accounted for as much as 80% of the shrimp catch of the European Union in this division (Vetemaa, 2008). Shrimp stocks have declined in the division 3L as well, and it was recommended to reduce exploitation rates in 2010.

In 2010, fishing for 3M cod and 3LN redfish (*Sebastes* spp) was reopened (closure had been applied with regard to both species since 1999) (NAFO, 2011). Commercial fishing is still closed for the following stocks: 3L and 3NO Atlantic cod *(Gadus morhua),* 3LNO and 3M American plaice *(Hippoglossoides platessoides),* 3L and 3NO witch flounder *(Glyptocephalus cynoglossus),* 3NO capelin *(Mallotus villosus)* and 3NO shrimp *(Pandalus borealis)* (NAFO, 2010).

The state of fish stocks in NEAFC fishing grounds is assessed by the ICES. Shrimp was the most important target species for Estonia in the NEAFC area from 2008–2010. In 2010 shrimp stocks were in good shape in the NEAFC fishing grounds: the fishing mortality rate was low and stable, the biomass index was also stable and close to the mean value of historical biomass levels, and the recruitment index (which had declined from 2004–2008) increased again in 2009 and 2010 (ICES, 2010a).

Shrimp, redfish and mackerel were the most important species for Estonia in the NEAFC fishing grounds, as Estonia has higher quotas for these species.

Stocks of beaked redfish (*Sebastes mentella*) and golden redfish (*Sebastes* *marinus*) are managed separately in the NEAFC area. Stocks of beaked redfish are in a poor state in the NEAFC area. It has been recommended to avoid directed trawling for this species until an increase in spaw stock biomass and in the abundance of juveniles is observed. As growth was very low from 1996–2005, the ICES recommends protecting spaw stock biomass since only a small number of new mature individuals will enter the stock over the next 12–15 years. The state of golden redfish stocks is a little better, but directed fishing is still not recommended (ICES, 2010a).

To maintain stable yield, a management plan was adopted for mackerel *(Scomber scombrus)* in the NEAFC area in 2008. Despite this, mackerel catches were in excess of the ICES advice in subsequent years, as there were no effective agreements between countries involved in the fishery. Fishing mortality was high during the 1990s, but has declined since 2002. The 2005 and 2006 year-classes were strong. Stocks were in relatively good condition in 2010, but it has still been recommended to maintain the closed areas and seasons in order to support a continued increase in stocks (ICES, 2010b).

Directed fishing for many deep-water species (e.g. deep-water sharks) is prohibited in the NEAFC area. In addition, many species of skates and rays may not be retained on board – all individuals being brought on board must be promptly released unharmed (Table 2, note 4). Overall, the stocks of a number of deep-water species were in poor condition in 2010.

Assessment and scientific advice concer stocks in the NAFO area are available on the website of the NAFO (www.nafo.int). Materials on NEAFC fishing grounds can be found on the website of the NEAFC (www.neafc.org) and on the website of the ICES (www.ices.dk, ICES Advice Book).

Fishing opportunities

Fishing opportunities are agreed between member states at the annual meetings of NAFO and NEAFC. From 2005–2010, vessels flying the Estonian flag could make use of fishing opportunities primarily on NAFO fishing grounds, but also in the NEAFC and Svalbard areas. Fishing companies acquired additional fishing opportunities through charter arrangements and quota transfers almost every year because the original opportunities were not sufficient, considering their fishing capacity. However, for some species the fishing opportunities were too small to be used and it was economically more reasonable to sell these. Table 2 presents Estonia's fishing opportunities before charter arrangements and quota transfers. This means that the figures given in the table differ from actual fishing opportunities, which depended on the operational strategies of the holders of the opportunities (such as purchase and sale or realisation of quotas).

Estonian vessels could also fish for unregulated species in international waters outside of the closed areas. Thus, after a three-year break (2007–2009) one vessel fished for several species of bony fish and squids in the South West Atlantic in 2010. There is no regional fisheries management organisation (RFMO) in the area, and no fishing opportunities have been allocated to Estonia there.

Catches

In 2005–2010, distant-water fishing vessels flying the flag of Estonia only fished in the Atlantic Ocean. Shrimp was the target species for most of Estonia's distant-water fishing vessels (3), but fish and squid species were also targeted. In 2009 shrimp, redfish and Greenland halibut provided the highest catches and also represented the top three species by value of catch (Figure 1 and Table 3). In 2010 Argentine hake, which are present in South West Atlantic fishing grounds, also made the top three. Catches were landed in ports of Canada, Spain, Greenland, Iceland, Uruguay and Norway.

Table 2. Estonia's distant-water fishing opportunities (quotas) from 2005–2010, before charter arrangements and quota transfers, in tonnes and fishing days, broken down by fishing ground

Species	Unit	Fishing area	2005	2006	2007	2008	2009	2010
Northern prawn, *Pandalus borealis*, PRA	Fishing day	NAFO 3M	1667	1667	1667	1667	1667	834
	Tonne	NAFO 3L	144	245	245	278	334	334
Redfish, *Sebastes* spp, RED	Tonne	NAFO 3M	1571	1571	1571	1571	1571	1571(1)
	Tonne	NAFO 3LN	0	0	0	0	0	173
Shortfin squid, *Illex illecebrosus*, SQI	Tonne	NAFO 3 and 4	128	128	128	128	128	128
Greenland halibut, *Reinhardtius hippoglossoides*, GHL	Tonne	NAFO 3LMNO	380	371	321	321	321	321
Skates and rays, *Rajidae*, SKA	Tonne	NAFO 3LNO	546	546	546	546	546	485
Atlantic cod, *Gadus morhua*, COD	Tonne	NAFO 3M	0	0	0	0	0	61
Mackerel, *Scomber scombrus*, MAC	Tonne	NEAFC	115	119	135	124	165	107
Roundnose grenadier, *Coryphaenoides rupestris*, RNG	Tonne	NEAFC	77	77	67	67	57	49
Black scabbardfish, *Aphanopus carbo*, BSF	Tonne	NEAFC	17	17	17	17	15	14
Dogfish sharks, *Squalidae* spp, DGX	Tonne	NEAFC	10	10	4	2	1(2)	0(3)
Blue ling, *Molva dypterygia*, BLI	Tonne	NEAFC	5	5	4	3	3	3
Redfish, *Sebastes* spp, RED	Tonne	NEAFC	344	284	210	210	210	210
Greenland halibut, *Reinhardtius hippoglossoides*, GHL	Tonne	NEAFC	10	8	6	6	4	3
Skates and rays, *Rajidae*, SKA(4)	Tonne	NEAFC					8	7
Northern prawn, *Pandalus borealis*, PRA	Fishing day	Svalbard	377	377	377	377	377	377
Total	Tonne		**3347**	**3381**	**3254**	**3273**	**3740**	**3843**
	Fishing day		**2044**	**2044**	**2044**	**2044**	**2044**	**1211**
Change in tonne quotas since 2005	Percent			**1**	**–3**	**–2**	**14**	**15**

Source: MoE and Commission Regulations No. 1359/2008, 43/2009 and 53/2010.

(1) Estonia's revised quota was 841 t, as the catches of 2009 exceeded the permitted quantity and the overfished quantity was counted against the quota for 2010.

(2) Exclusively for by-catches. No directed fishing for deep-sea sharks is permitted.

(3) By-catches are permitted up to 10% of the quotas for 2009.

(4) Catches of cuckoo ray (*Leucoraja naevus*), thornback ray (*Raja clavata*), blonde ray (*Raja brachyura*), spotted ray (*Raja montagui*), small-eyed ray (*Raja microocellata*), sandy ray (*Leucoraja circularis*) and shagreen ray (*Leucoraja fullonica*) are reported separately. Does not apply to undulate ray (*Raja undulata*), common skate (*Dipturus batis*), Norwegian skate (*Raja* (Dipturus) *nidarosiensis*) and white skate (*Rostroraja alba*). Catches of these species may not be retained on board and must be promptly released unharmed to the extent practicable. Fishermen are encouraged to develop and use techniques and equipment to facilitate the rapid and safe release of these species.

Table 3. Estonia's distant-water fishery catches (t) by species, 2005–2010

Species		2005	2006	2007	2008	2009	2010
Blue antimora	*Antimora rostrata*			3			
Argentine shortfin squid	*Illex argentinus*	581	499				42
Argentine hake	*Merluccius hubbsi*		700				1125
Patagonian grenadier	*Macruronus magellanicus*		73				135
Greenland shark	*Somniosus microcephalus*	9					
Baird's slickhead	*Alepocephalus bairdii*	64	158	9	<1		<1
Rabbit fish	*Chimaera monstrosa*	4	2		<1		<1
Atlantic halibut	*Hippoglossus hippoglossus*				3	<1	3
American plaice	*Hippoglossoides platessoides*	47	34	33	77	29	9
Splendid alfonsino	*Beryx splendens*		4				
Atlantic wolffish	*Anarhichas lupus*				12	5	<1
Northern prawn	*Pandalus borealis*	12 381	9242	12 076	12 742	8587	9037
Roundnose grenadier	*Coryphaenoides rupestris*	154	104	140	<1		<1
Mediterranean slimehead	*Hoplostethus mediterraneus*		1				
Haddock	*Melanogrammus aeglefinus*	<1					
Cusk-eels	*Genypterus* spp	17	1				
Golden redfish	*Sebastes marinus*		104				
Alfonsinos	*Beryx* spp			1			
Pink cusk-eel	*Genypterus blacodes*		22				
Northern shortfin squid	*Illex illecebrosus*		24			5	1
Redfish	*Sebastes* spp	1111	1156	1040	1003	1748	1340
Wolffish	*Anarhichas* spp	74	63	10	2	<1	<1
Hakes	*Merluccius* spp	700	6				
Black cardinal fish	*Epigonus telescopus*		<1				
Black dogfish	*Centroscyllium fabricii*		4	6	<1		<1
Beaked redfish	*Sebastes mentella*		396	684	<1		<1
Antarctic rockcods	*Nototheniidae*	56	127				58
Dogfish sharks	*Squalidae*	6		3	3	<1	<1
Patagonian squid	*Loligo gahi*						44
Patagonian toothfish	*Dissostichus eleginoides*		<1				
Tadpole codling	*Salilota australis*		32				1
Longnose velvet dogfish	*Centroscymnus crepidater*			3	<1		<1
Witch flounder	*Glyptocephalus cynoglossus*	31	28	24	38	8	11
Portuguese dogfish	*Centroscymnus coelolpis*	7	7				
Red hake	*Urophycis chuss*	47	26	2			19
Roughhead grenadier	*Macrourus berglax*	103	95	69	132	41	93
Raja rays	*Raja* spp	62	258	366	123	29	228
Rays, stingrays, mantas	*Rajiformes*	479	<1		<1		<1
Yellowtail flounder	*Limanda ferruginea*	20	6	25	33	<1	4
Blue ling	*Molva dypterygia*	5	3	7	<1		<1
Black scabbardfish	*Aphanopus carbo*	11	6	7	<1		<1
Greenland halibut	*Reinhardtius hippoglossoides*	534	373	365	299	300	441
Threebearded rockling	*Gaidropsarus ensis*					1	3
Cod (Atlantic cod)	*Gadus morhua*	33	52	25	73	128	93
Spotted wolffish	*Anarhichas minor*						12
White hake	*Urophycis tenuis*	1	<1	32	19	<1	<1
Sharks, rays, skates etc.	*Elasmobranchii*		11				
Total		**16 539**	**13 617**	**14 930**	**14 559**	**10 881**	**12 699**

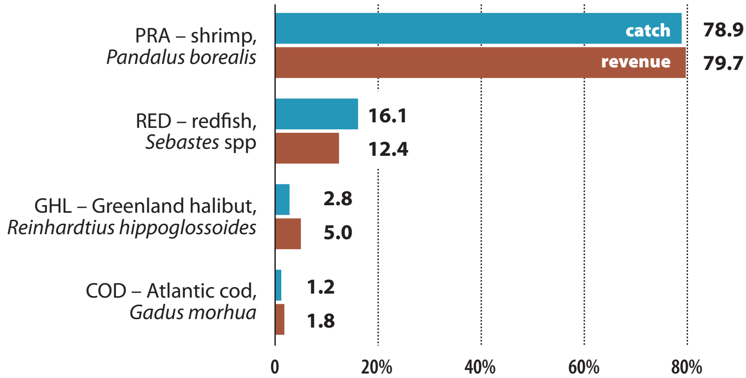
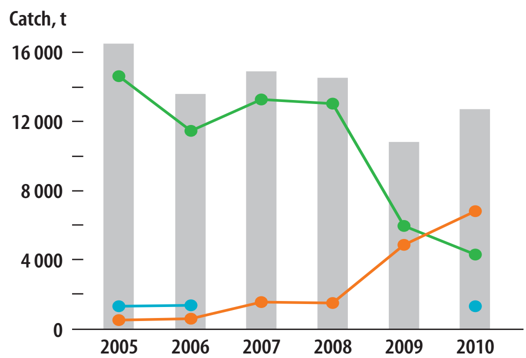


Figure 1. **Percentage distribution of catch and revenue by main target species in distant-water fishing sector in 2009.** Source: MoA, UT EMI



	2005	2006	2007	2008	2009	2010
Total	16 539	13 617	14 930	14 559	10 881	12 699
North West Atlantic	14 690	11 515	13 332	13 086	5979	4329
North East Atlantic	494	633	1598	1473	4903	6906
South West Atlantic	1355	1469				1464

Figure 2. **Estonia's distant-water fishery catches (t) by fishing ground, 2005–2010.** Source: MoA

Table 4. **Percentage changes (%) in distant-water fishery catches (t), 2005–2010**

	2005	2006	2007	2008	2009	2010
Shrimp	12 381	9242	12 076	12 742	8587	9037
Change since 2005 (%)		–25	–2	3	–31	–27
Fish and squids	4158	4374	2854	1817	2294	3662
Change since 2005 (%)		5	–31	–56	–45	–12
Total	**16 539**	**13 617**	**14 930**	**14 559**	**10 881**	**12 699**
Percent		**–18**	**–10**	**–12**	**–34**	**–23**

Source: MoA

From 2008–2010, distant-water fishing vessels flying the flag of Estonia did not use the fishing opportunities in the NEAFC area, as they were fishing in either NAFO or international waters in the South West Atlantic. As shrimp fishery opportunities had been reduced in the NAFO division 3M since 2007 and commercial fishing for shrimp was closed in full in 2011, shrimp vessels looked for other fishing opportunities. Therefore, during the period 2008–2010 most of the fishing efforts shifted to the NEAFC fishing grounds (specifically the Barents Sea), where Estonian vessels fished for shrimp. Until 2005 the importance of the Eastern Atlantic fishing grounds declined steadily (Aps *et al.*, 2005), but catches increased in the period 2005–2010 in the NEAFC fishing grounds and in 2010 exceeded those of the NAFO fishing grounds (Figure 2).

In 2010 the total catch was 23% lower than in 2005 (12,699 t and 16,539 t respectively). Shrimp catches accounted for most of the decline (27%), while fish catches declined by 12%. In 2008, fish catches (except shrimp) decreased by 56% compared to 2005, which was the largest decline over the period 2005–2010 (Table 4).

Economy

In 2009, employment declined by 59% in the distant-water fishery sector compared to 2005 (94 and 232 employees respectively). The number of fishing companies was four in 2005 and two in 2010. These changes stemmed from diminishing fishing opportunities and an unfavourable economic situation where first sale prices did not change significantly, while fishing-related expenses increased. However, the average first sale price for shrimp slightly increased over the period 2005–2010 (Table 5). Revenue from the distant-water fishery sector, calculated on the basis of average first sale prices and catches, amounted to 20–26 million euros in the period 2005–2009.

Outlook

The importance of shrimp fishing in the NAFO division 3L will probably continue to decline after 2010, as the stocks will deteriorate in 2011 and fishing opportunities will decrease. Vessels will be seeking fishing opportunities on the basis of charter arrangements in the NAFO divisions where Estonia otherwise has no fishing rights. On the other hand, the opportunities to catch some species will most likely improve in the NAFO area, as fishing for 3LN redfish and 3M cod was opened in 2010. Fishing will probably also continue in the South West Atlantic fishing grounds if there are insufficient fishing opportunities in the North East and/or North West Atlantic fishing grounds for vessels that target fish. The North East Atlantic fishing grounds are likely to be an important shrimp fishing area for Estonian vessels for at least the next few years.

Table 5. Average first sale prices (€ kg^{-1}), 2005–2009

Species		2005	2006	2007	2008	2009
Blue antimora	*Antimora rostrata*			0.70		
Argentine shortfin squid	*Illex argentinus*		1.25			
Argentine hake	*Merluccius hubbsi*		1.77			
Patagonian grenadier	*Macruronus magellanicus*		1.32			
Baird's slickhead	*Alepocephalus bairdii*	1.91	2.87	0.70		
Squids	*Loliginidae, Ommastrephidae*	1.21				
Rabbit fish	*Chimaera monstrosa*		1.62			
Atlantic halibut	*Hippoglossus hippoglossus*				0.50	
American plaice	*Hippoglossoides platessoides*	2.51	2.55	3.61	2.77	3.31
Splendid alfonsino	*Beryx splendens*		2.50			
Northern prawn	*Pandalus borealis*	1.49	1.55	1.68	1.82	1.85
Silver hake	*Merluccius bilinearis*	1.05				
Roundnose grenadier	*Coryphaenoides rupestris*		1.07			
Mediterranean slimehead	*Hoplostethus mediterraneus*		1.48			
Haddock	*Melanogrammus aeglefinus*	<0.01				
Alfonsinos	*Beryx* spp			4.01		
Pink cusk-eel	*Genypterus blacodes*		1.92			
Southern blue whiting	*Micromesistius australis*		1.27			
Northern shortfin squid	*Illex illecebrosus*		0.27			0.55
Redfish	*Sebastes* spp	2.10	1.74	1.76	1.36	1.41
Wolffish	*Anarhichas* spp	1.23	0.86	1.20	0.50	0.55
Black cardinal fish	*Epigonus telescopus*		1.33			
Black dogfish	*Centroscyllium fabricii*		2.23	2.13		
Beaked redfish	*Sebastes mentella*			1.94		
Antarctic rockcods	*Nototheniidae*		1.02			
Dogfish sharks	*Squalidae*	2.74		1.40	1.40	
Tadpole codling	*Salilota australis*		1.46			
Longnose velvet dogfish	*Centroscymnus crepidater*			0.84		
Witch flounder	*Glyptocephalus cynoglossus*	2.17	1.95	2.17	1.43	1.90
Portuguese dogfish	*Centroscymnus coelolpis*		1.43			
Red hake	*Urophycis chuss*	1.20	0.36	0.60		
Roughhead grenadier	*Macrourus berglax*	1.75	1.34	1.40	0.45	1.58
Raja rays	*Raja* spp	1.38	1.44	2.29	2.05	1.46
Yellowtail flounder	*Limanda ferruginea*	1.75	0.75	3.30	0.65	
Blue ling	*Molva dypterygia*	2.44	2.58	0.60		
Black scabbardfish	*Aphanopus carbo*	3.29	1.85	0.80		
Greenland halibut	*Reinhardtius hippoglossoides*	3.75	3.54	3.71	2.50	3.30
Threebearded rockling	*Gaidropsarus ensis*				0.46	0.41
Cod (Atlantic cod)	*Gadus morhua*	2.96	2.81	3.81	2.66	2.80
White hake	*Urophycis tenuis*			1.99		
Sharks, rays, skates, etc.	*Elasmobranchii*		0.92			

Source: UT EMI

Baltic Sea fisheries

BALTIC COASTAL FISHERY

According to the data entered in the Fishing Vessel Register, there were 1808 coastal fishermen fishing in the Baltic Sea in 2010 who used 872 fishing vessels. While the number of coastal fishermen declined during the period of booming economic growth as they found better-paid jobs, their numbers started to increase again when the recession hit (Figure 3).

It has been estimated that fishing was the main source of income for around 10% of coastal fishermen. Most of these fishermen were engaged in agriculture or other fields of activity besides coastal fishery. By county, the numbers of coastal fishermen were as follows in 2010:

Pärnu County (incl. Manija and Kihnu)	395
Saare County (incl. Ruhnu)	381
Hiiu County (incl. Vormsi)	252
Lääne County	229
Harju County	292
Lääne-Viru County	121
Ida-Viru County (excl. Lake Peipsi)	138

In 2010 the catches of coastal fishermen included 36 different fish species, two species of cyclostomes and Baltic prawn; hence, the total number of species caught was 39. Many of these species were only caught as single individuals whose quantities, when rounded, were less than 0.01 t (Table 6). Nearly a quarter of the species caught accounted for less than 0.1% of the catch. Herring produced the biggest catches, followed by perch, smelt, flounder, garfish and

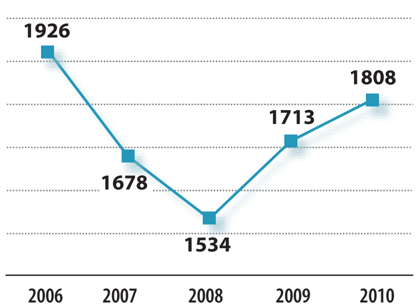


Figure 3. Number of coastal fishermen fishing in Baltic Sea, 2006–2010.
Source: MoE, MoA

pikeperch. Based on average first sale prices, coastal fishermen earned the most from perch fishing. In terms of profitability, perch was followed by herring, pikeperch, smelt, flounder and whitefish (Figure 4). The sales revenue of Estonian coastal fishermen, calculated on the basis of official first sale prices, amounted to around 3.35 million euros in 2010.

While the first sale prices of pikeperch, whitefish and smelt increased in 2010, those of other major species have been fairly stable over the last five years (Figure 5, Table 7).

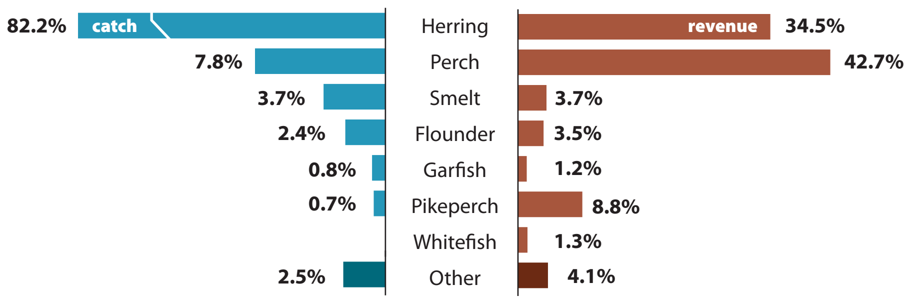
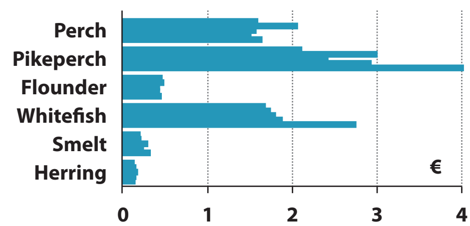


Figure 4. **Distribution of catches and revenue in coastal fishing by species in 2010.** Source: MoA

Figure 5. Average first sale prices of fish species most important to coastal fishery (€ kg^{-1}), 2006–2010. Source: MoA



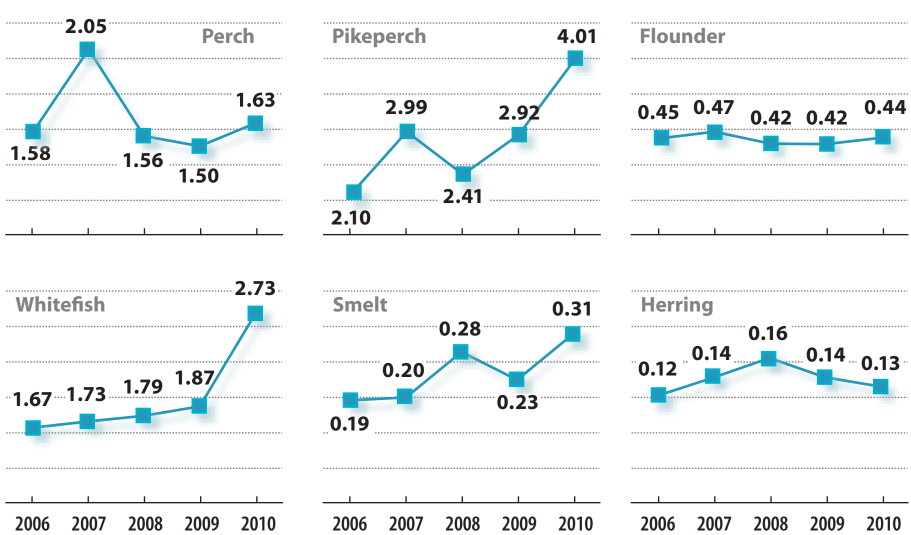


Table 6. Coastal fishing catches (t) and share (%) in total catch from Baltic Sea in 2010 by species

Species	Catch, t	% of total catch
Perch	878.76	7.8
Eel	3.45	0.0
Eelpout	0.81	0.0
Turbot	0.18	0.0
Atlantic mackerel	<0.01	0.0
Pike	22.77	0.2
Gibel carp	51.32	0.5
Lamprey	0.57	0.0
Carp	0.14	0.0
Ruff	32.36	0.3
Sprat	0.15	0.0
Pikeperch	73.36	0.7
Bream	3.58	0.0
Flounder	269.77	2.4
Tench	2.26	0.0
Burbot	1.30	0.0
Salmon	3.80	0.0
Baltic prawn	0.03	0.0
Sea trout	12.21	0.1
Four-horned sculpin	0.03	0.0
Whitefish	15.54	0.1
Sea lamprey	0.03	0.0
Smelt	417.31	3.7
Lumpfish	<0.01	0.0
Sabre carp	<0.01	0.0
Silver bream	21.60	0.2
Stickleback	0.02	0.0
Rudd	1.19	0.0
Herring	9236.65	82.2
Ide	6.30	0.1
Roach	66.48	0.6
Dace	<0.01	0.0
Cod	3.69	0.0
Garfish	86.05	0.8
Bleak	0.11	0.0
Rainbow trout	0.09	0.0
Vimba bream	29.82	0.3
Twaite shad	0.03	0.0
Round goby	1.12	0.0
Total	**11 242.89**	**100.0**

Source: MoA

Table 7. **Average first sale prices of fish as published in official publication *Ametlikud Teadaanded* (€ kg^{-1}), 2006–2010**

Species	Year				
	2006	2007	2008	2009	2010
Perch	1.58	2.05	1.56	1.50	1.63
Eel	5.92	5.68	5.58	5.14	5.72
Eelpout	0.06		0.13		0.36
Pike	0.84	0.92	0.98	1.05	1.05
Gibel carp	0.14	0.12	0.14	0.12	0.11
Lamprey	1.95	1.96	1.88	1.76	1.68
Common carp	0.40	0.31	0.27	0.74	0.94
Ruff	0.06	0.10	0.08	0.09	0.13
Sprat	0.12	0.15	0.17	0.15	0.13
Crucian carp	0.11	0.04		0.32	0.30
Pikeperch	2.10	2.99	2.41	2.92	4.01
Bream	0.35	0.38	0.40	0.49	0.45
Flounder	0.45	0.47	0.42	0.42	0.44
Tench	0.73	0.76	0.95	0.80	0.86
Burbot	0.55	0.52	0.56	0.61	0.63
Salmon	2.79	1.35	3.29	1.64	2.63
Baltic prawn				2.36	
Sea trout	1.87	2.55	2.05	1.47	1.68
Whitefish	1.67	1.73	1.79	1.87	2.74
Smelt	0.19	0.20	0.28	0.23	0.31
Silver bream	0.07	0.07	0.07	0.07	0.09
Lake Peipsi whitefish	1.31	0.81	0.99	1.04	0.94
Lake Peipsi smelt	0.41				
Rudd	0.11	0.03	0.13	0.07	0.04
Herring	0.12	0.14	0.16	0.14	0.13
Vendace		1.04	1.01	1.43	2.88
Ide	0.28	0.40	0.39	0.42	0.46
Roach	0.16	0.28	0.39	0.39	0.44
European chub				0.19	
Cod (Atlantic cod)	1.43	0.80	0.55	1.10	0.92
Garfish	0.28	0.37	0.38	0.43	0.47
Bleak			0.13	0.03	0.13
Rainbow trout				1.92	
Vimba bream	0.20	0.28	0.23	0.23	0.38
Round goby		0.20	0.25	0.34	0.32

Dynamics of coastal fishing catches in different parts of Baltic Sea

Gulf of Finland

Gill nets and trap nets are the main fishing gear in coastal fishing. The biggest catches taken in the Gulf of Finland with such gear are those of herring, followed by flounder, perch, whitefish, smelt, sea trout and garfish (Table 8). Herring produces the biggest sales revenue, followed by perch and flounder.

Herring is mostly caught with trap nets. Herring catches were significantly higher in 2009 and 2010 than in 2007 and 2008, but the state of stocks is deteriorating and catches will be limited by reduced quotas. **Flounder** is mostly caught with gill nets in the western part of the gulf. Flounder catches were relatively stable from 2007–2010, but the stock is decli due to the deteriorating situation in the spaw grounds of deep flounder. Gill nets are the main fishing gear for catching **perch**; trap net catches were mostly half the size. Perch stocks are expected to increase to some extent in the near future. **Whitefish** is caught from the Gulf of Finland mainly with gill nets. Whitefish catches showed a decreasing trend from 2007–2010. The catch of 2010 was the smallest during the period. Also **smelt** is caught mainly with gill nets. The catch of 2010 amounted to less than half the catches taken in the two preceding years. Smelt stocks seem to be decreasing in the Gulf of Finland. In **sea trout** and **salmon** fishing mostly gill nets are used. Catches of these valuable fish species are not expected to increase significantly in the near future. Catches of **round goby**, an alien species, have increased steadily. In the future, this species might start competing for food with other fish species, particularly demersal fish such as flounder and eelpout, and there is no solution to this problem.

In conclusion, total catches increased from 2007 to 2010 due to growing herring catches. With these catches not taken into account, the total catch of 2010 was the smallest during the period under review.

High seas

Fishing gear used in coastal regions towards the Baltic Proper near Saaremaa and Hiiumaa include gill nets, trap nets, longlines and seine nets. The species caught are dominated by flounder, followed by garfish, herring, roach, perch, sea trout, ide, whitefish and pike (Table 9). In 2010, flounder produced the biggest sales revenue (63,000 euros), which was 10 times higher than the sales revenue for perch (6300 euros). Sales revenue provided by other species was significantly lower.

In **flounder** fishing the main fishing gear included gill nets (66% of the catch), seine nets (27%) and trap nets (7%) over the last four years. Flounder catches increased from 2007–2009, but declined slightly below the average of the period under review in 2010. Flounder stocks are decreasing due to the deteriorating situation in the spaw grounds of deep flounder. In terms of catch volume, **garfish** is the second most important species in this area. This species is mostly caught with trap nets. In this area, **herring** only occupies third place in terms of catch volume. Trap nets are the main fishing gear in herring fishing, but the share of gill nets in catches is higher than in other parts of the coastal sea. Herring catches increased from 2007–2009, with the record catch of the period taken in 2009. The state of herring stocks is likely to deteriorate in the coming years, and catches will be limited by reduced quotas. **Roach** has become the most important freshwater species, whose catches even exceed those of **perch**.

In conclusion, catches increased in coastal regions towards the Baltic Proper near Saaremaa and Hiiumaa from 2007–2009, but declined in 2010.

Väinameri Sea

Fishing gear used in the Väinameri Sea (ICES subdivision 29-4) includes gill nets, trap nets and longlines. By volume, herring dominates the catches here, followed by garfish, perch, Gibel carp, roach, flounder, pike, silver bream and ide (Table 10). The greatest revenue in 2010 was provided by perch (39,000 euros), herring (30,000 euros) and pike (13,000 euros).

Herring is mostly caught with trap nets. Herring catches increased significantly in the period 2007–2010. The catch of 2010 was the biggest over these years. The state of stocks does not enable catches to be further increased, however. **Garfish** is caught primarily with trap nets as well. The record catch of the period 2007–2010 was taken from the Väinameri Sea in 2007, but catches declined in subsequent years. **Perch** is fished mostly with gill nets, but considerable quantities are caught with trap nets as well. Catches fluctuated in the period 2007–2010 significantly as fishing for perch relies on just a few year classes. The state of perch stocks is improving in the Väinameri Sea. **Gibel carp** has become the fourth most important fish species in terms of quantities caught. Most Gibel carp catches are taken with gill nets. The rapid increase in the population of Gibel carp has stopped in the area. The share of gill nets and trap nets is more or less equal in **roach** fishing. Catches have been stable over the last four years. **Pike** is caught in the Väinameri Sea mainly with gill nets, with the share of trap nets in the catch usually being two times smaller. Current pike catches are not comparable to past catches taken from the Väinameri Sea, but the catch of 2010 was the biggest over the last four years and new, stronger year classes are entering catches. From 2007–2010 a decli trend could be observed in the catches of many fish species, such as **ide**, **ruff**, **whitefish**, **tench**, **rudd**, **burbot**, **eel** and **smelt**. **Pikeperch** catches in the area still amount to less than half a tonne, but the catch of 2010 was significantly larger than in the previous three years.

In conclusion, catches were significantly lower in the Väinameri Sea in 2007 and 2008 than in 2009 and 2010, which can be explained by large herring catches during the latter years. If herring is not taken into account, the largest catches were taken from the Väinameri Sea in 2007.

Gulf of Riga

Fishing gear used in the Gulf of Riga (except Pärnu Bay) includes gill nets, trap nets, seines and longlines. Gill nets and trap nets are the main fishing gear. Herring prevails in catches taken from the Gulf of Riga with all fishing gear, followed by perch, garfish, roach, flounder, ruff, Crucian carp, Gibel carp, vimba bream, pike, whitefish, smelt and eel (Table 11). The biggest revenue in 2010 was produced by perch (306,000 euros), herring (204,000 euros) and roach (14,000 euros).

Herring is mostly caught with trap nets and less so with gill nets. The herring catch of 2010 exceeded the average catch in the years 2007–2010. Herring stocks have been managed quite sustainably in recent years, and the state of stocks has been stable. **Perch** is fished mostly with gill nets, but considerable quantities are caught with trap nets as well. Catches were rather stable from

2007–2010. The catch of 2010 fell short of the average catch for said period. **Garfish** is caught primarily with trap nets. The record catch of the period under review was taken from the Gulf of Riga in 2008. Trap nets are used more than gill nets in **roach** fishing. Catches in 2009 and 2010 exceeded those of the two preceding years. **Flounder** is mostly caught with trap nets in the Gulf of Riga. In 2010 an exceptionally large quantity was caught with seine nets as well. Flounder catches and stocks are decli.

In conclusion, catches were higher in the Gulf of Riga in 2007 and 2008 than in 2009 and 2010. This difference primarily resulted from larger herring catches in 2007. If herring is not taken into account, the largest catches were taken from the Gulf of Riga in 2009.

Pärnu Bay

Fishing gear used in Pärnu Bay (fishing squares 178–180) include gill nets, trap nets, seines and longlines. Herring prevails in catches taken from the bay with all fishing gear, followed by smelt, perch, pikeperch, vimba bream, silver bream, roach, ruff, Crucian carp and garfish (Table 12). The biggest revenue in 2010 was produced by perch (1 million euros), herring (823,000 euros), pikeperch (284,000 euros) and smelt (126,000 euros).

Herring is mostly caught with trap nets. Herring catches fluctuated greatly in the period 2007–2010. The herring catch of 2010 was higher than average during the period, but lower than in the two preceding years. Stocks are stable, but catches depend on the prevailing weather in the fishing period as well as on coastal fishing quotas to a great extent. **Perch** catches are stable and the state of stocks is average, but the high proportion of undersized fish in catches and the intensive exploitation of stocks are of concern. Based on an analysis of test and commercial catches, the state of **pikeperch** and **vimba bream** as important commercial fish species in Pärnu Bay is not good, and there are a lot of undersized or barely mature individuals in catches. However, in the case of perch and pikeperch, reproductive success is higher in Pärnu Bay than elsewhere in coastal waters, and controls on catch limits (in particular as regards the catch of undersized fish) should be enhanced to improve the situation. **Smelt** catches increased from 2007 to 2010. However, the catch of 2010 did not exceed that of 2007. In addition to the state of stocks, commercial fishing catches of smelt during the spaw period also depend on the hydro-meteorological conditions (including ice conditions) prevailing at the time of fishing to a great extent. The decline of stocks is obvious, however. **Garfish** is caught primarily with trap nets. From 2007–2010, the largest catch was taken from Pärnu Bay in 2010. Catches have increased steadily over the past four years.

In conclusion, catches taken from Pärnu Bay in the period 2007–2010 have fluctuated to a great extent. The total catch of 2010 was higher than average during the period observed, but lower than in the two preceding years. The total catch mostly depends on catches of herring and smelt. With herring catches not taken into account, no significant changes were observed in the total catches for the years 2007–2010. If smelt is excluded as well, the catches of other species were largest over the last four years in 2010.

Table 8. Species composition and catches (kg) of commercial fishing in Gulf of Finland (ICES division 32) broken down by coastal fishing gear, 2007–2010

Species /	2007				2008				2009				2010				2007-2010
Fishing gear	Trap nets	Gill nets	Longlines	Total	Trap nets	Gill nets	Longlines	Total	Trap nets	Gill nets	Longlines	Total	Trap nets	Gill nets	Longlines	Total	Average
Perch	11 119	24 876	6	36 000	20 821	56 185		77 005	34 724	37763	29	72 516	16 598	33 467		50 066	58 897
Eel	2402	13	15	2429	2102	4	7	2113	1714	21	4	1739	1317	54	2	1373	1913
Eelpout	43	5		48	1			1	15	2		18	7	2		9	19
Atlantic mackerel														1		1	0
Grayling										1		1					0
Pike	120	1545		1664	111	1453		1564	161	1176		1337	225	1540		1766	1583
Gibel carp	66	3362		3428	334	5593		5926	470	4128		4598	947	3575		4522	4619
Lamprey		46		46													12
Turbot		12		12		32		32	11	42		53	22	50		73	42
Carp						1		1		8		8	8	8		16	6
Ruff	45	52		97	5	152		157	2	180		182	24	17		41	119
Sprat					35	178		213	80	1		81	2			2	74
Crucian carp	142	1691		1832					5	85		90	219	873		1092	753
Pikeperch	159	2262		2420	211	11 011		11 222	555	418		973	579	446		1025	3910
Bream	1397	1573		2970	1015	2017		3032	948	884		1831	600	317		918	2188
Flounder	4940	99 255	91	104 285	5113	80 972	55	86 139	5120	96 368	69	101 557	7535	88 171	20	95 725	96 927
Tench	1	5		5	2	3		4	4	75		79	115	29		144	58
Burbot	39	53		92	5	43		48	5	18		22		10		10	43
Salmon	731	3091		3822	666	3443		4108	638	3002		3640	614	1879		2493	3516
Sea trout	1560	11 629		13 189	430	7841		8271	459	8603		9062	1143	8040		9182	9926
Four-horned sculpin						9		9						31		31	10
Whitefish	1263	20 494		21 756	917	22 195		23 112	825	14 177		15 003	727	10 064		10 791	17 666
Smelt	417	15 110		15 527	492	21 285		21 777	530	20 309		20 838	427	9404		9831	16 993
Lumpfish														1		1	0
Sabre carp														1		1	0
Silver bream	160	695		855	326	460		786	539	461		1000	332	150		482	781
Rudd	13	12		24		68		68	14	10		24	235	4		239	89
Herring	221 305	2075		223 381	553 087	2905		555 992	1 132 459	7511		1 139 971	1 095 410	3031		1 098 441	754 446
Ide	14	199		213	61	342		403	60	250		310	50	158		208	283
Roach	526	2136		2662	499	2318		2817	1246	3525		4771	1785	1043		2828	3269
Dace						1		1									0
Cod	20	66		86	22	832		854	8	1872	2	1882	67	2057		2124	1236
Garfish	9127	189	1	9317	1318	31		1349	6535	194		6729	13092	68		13160	7639
Bleak	41	3		44	51	11		62	27			27	29	2		31	41
Rainbow trout	6	104		110	22	203		224	8	173		181	2	74		76	148
Vimba bream	377	3624		4000	234	2758		2991	1118	700		1818	915	699		1613	2606
Twaite shad														13		13	3
Round goby		89		89	4	360		364	22	464	6	492	235	878	8	1121	516
Other species		2		2													1
Total	256 030	194 264	112	450 406	587 880	222 702	62	810 644	1 188 298	202 422	110	1 390 830	1 143 260	166 156	30	1 309 445	990 331

Source: MoA

Table 9. **Species composition and catches (kg) of commercial fishing in Baltic Proper (ICES subdivisions 28-2 and 29-2) broken down by coastal fishing gear, 2007–2010**

Species /	2007					2008					2009					2010					2007-2010
Fishing gear	Trap nets	Gill nets	Seine nets	Longl-ines	Total	Trap nets	Gill nets	Seine nets	Longl-ines	Total	Trap nets	Gill nets	Seine nets	Longl-ines	Total	Trap nets	Gill nets	Seine nets	Longl-ines	Total	Average
Perch	582	1958			2540	494	1472		8	1974	1300	3747	80	2	5129	1058	2664	115	30	3867	3377
Eel	663	5		19	687	454			2	456	520	6		34	560	381	2		9	391	523
Eelpout	19				19	6				6	22	2			24	19				19	17
Pike	334	743	2		1079	496	974			1470	548	653			1201	1008	1214		20	2242	1498
Gibel carp		53			53	219	787		2	1008	464	1189			1652	815	751		14	1580	1073
Turbot												1			1	25	84			109	28
Carp		13			13																3
Grey mullets		3			3																1
Ruff	34	7			41	19	6			25	39	4			43	11	12			23	33
Sprat		0			0						15				15						4
Crucian carp	163	1039	6		1208																302
Pikeperch							2			2											1
Bream	7				7	1				1	1	3			4	2				2	4
Flounder	12 404	98 894	4641	2	115 941	12 083	97 313	51 187	38	160 621	9636	100 758	50 888	9	161 291	8618	83 237	51 916	71	143 842	145 424
Tench	8				8	2	1			3	8	2			10	11	13		7	31	13
Burbot	587	588			1176	270	267			536	460	200			660	392	271		10	674	761
Salmon	10	890			900	15	766			781	14	957			971	12	369			381	758
Sea trout	40	3156			3196	54	2777			2831	93	3798			3891	117	1863			1979	2974
Four-horned sculpin		7			7		4			4		5			5						4
Whitefish	32	2541			2573	45	2158			2203	24	1375			1399	25	1180			1205	1845
Smelt		2			2		30			30		3			3		7			7	10
Lumpfish		1			1		2			2											1
Sabre carp																	1			1	0
Silver bream		1			1						0	84			84						21
Rudd	22				22	29				29	20	1			21	30	9			39	28
Herring	4710	846			5556	5499	1853			7351	10 875	3763			14 638	5728	1895		22	7645	8798
Ide	313	1513	20	4	1850	468	3146			3614	566	1987		11	2564	741	1849	8	32	2629	2664
Roach	2672	1663	10		4345	2351	2729		5	5085	2700	1780	720		5199	3965	1751		13	5729	5089
Dace		0			0																0
Cod	45	534			579	213	811		4	1028	207	1472			1679	199	909			1108	1099
Garfish	15 724	604		11	16 339	8485	830		10	9325	6270	310		12	6592	7827	253		10	8090	10 086
Bleak	17				17	25	5			30	12	2			13	38	7			45	26
Rainbow trout	2	75			77	5	80			85	13	48			61	3	14			18	60
Vimba bream	1	4			4		4			4		4			4	5	7			12	6
Twaite shad	1				1											11	1			12	3
Total	38 387	115 140	4679	36	158 242	31 232	116 016	51 187	69	198 504	33 805	122 153	51 688	68	207 714	31 040	98 363	52 039	238	181 679	186 535

Source: MoA

Table 10. **Species composition and catches (kg) of commercial fishing in Väinameri Sea (ICES subdivision 29-4) broken down by coastal fishing gear, 2007–2010**

Species /	2007				2008				2009				2010				2007-2010
Fishing gear	Trap nets	Gill nets	Longlines	Total	Trap nets	Gill nets	Longlines	Total	Trap nets	Gill nets	Longlines	Total	Trap nets	Gill nets	Longlines	Total	Average
Perch	1825	18 802	46	20 673	2031	9551	25	11 608	2519	12 038	14	14 571	3737	19 847	72	23 655	17 627
Eel	631	18	13	662	637	12	13	662	432	9	6	447	380		5	384	539
Eelpout	9	1		10	14			14					19			19	11
Pike	2712	5068	7	7787	3074	5374	1	8449	2791	5017		7808	4463	7770	18	12 251	9074
Gibel carp	35	17		52	7175	17 744	3	24 922	3965	15 362		19 328	4571	17 419	1	21 990	16 573
Carp	11	8		19	7	31		38	16	24		40	22	2		24	30
Ruff	4434	92	1	4527	4408	25		4433	1081	148		1228	712	88	11	811	2750
Sprat		25		25		21		21		7		7	50	18		68	30
Crucian carp	4336	12 825	13	17 173													4293
Pikeperch	12	120		132	44	84		128	12	127		139	127	262		388	197
Bream	212	206		418	168	76		244	84	109		193	110	206		316	292
Flounder	1775	6880		8655	1953	6405		8358	2321	7892	1	10 215	2412	8827	21	11 260	9622
Tench	1779	40		1819	1678	4		1682	1143	608		1751	1075	207		1282	1633
Burbot	533	720		1253	279	224		503	178	318		496	94	331		424	669
Salmon	16	84		100	21	86		106	8	124		132	31	90		121	115
Sea trout		313		313	36	176		212	37	258		295	2	244		246	266
Whitefish	61	3179		3240	59	1939		1998	49	1870	10	1930	70	1339		1408	2144
Smelt	1042	15		1057	468	29		497	279	26		305	129	38		167	506
Silver bream	2333	7116		9449	2786	6102		8888	1493	6616		8109	1550	6254		7804	8562
Stickleback	213			213	8			8									55
Rudd	1744	244		1988	1275	90		1365	484	507		991	498	416		914	1314
Herring	9110	2431		11 541	33 579	4612		38 191	216 230	3322		219 552	228 994	2430	8	231 432	125 179
Ide	2736	4086	38	6860	3178	3509	9	6696	2358	3080	3	5440	1702	1520	18	3241	5559
Roach	7480	7155	5	14 639	6826	6953	2	13 781	6215	7492	2	13 709	5915	7774	10	13 699	13 957
Dace						3		3									1
European chub						15		15		20		20					9
Cod	1	5		6		7		7	3	39		42	5	51		56	28
Garfish	37 991	339	90	38 420	20 668	615	71	21 353	19 297	1152	36	20 485	19 292	246	63	19 601	24 964
Bleak	50	66		116	35	20		55	31			31	33			33	59
Rainbow trout	2	8		10					4	2		6					4
Vimba bream	279	977		1255	289	538		827	713	1225		1938	778	2285		3063	1771
Other species		8		8													2
Total	81 360	70 843	213	152 416	90 693	64 244	124	155 061	261 741	67 391	72	329 204	276 767	77 663	226	354656	247 834

Source: MoA

Table 11. Species composition and catches (kg) of commercial fishing in Gulf of Riga (ICES subdivision 28-1, except Pärnu Bay) broken down by coastal fishing gear, 2007–2010

Species /	2007					2008					2009					2010					2007-2010
Fishing gear	Trap nets	Gill nets	Seine nets	Long-lines	Total	Trap nets	Gill nets	Seine nets	Long-lines	Total	Trap nets	Gill nets	Seine nets	Long-lines	Total	Trap nets	Gill nets	Seine nets	Long-lines	Total	Average
Perch	10 421	196 071		4835	211 326	10 326	17 1554		1595	183 475	7117	205 629		1193	213 939	7175	180 483		136	187 794	199 134
Eel	2096	3		15	2115	1690	4		8	1703	1440	15		4	1459	1219	1		10	1230	1627
Eelpout	8		65		73	27		65		92	29				29	2				2	49
Pike	1064	1573			2637	1369	1505			2874	1585	957			2542	3027	1784			4811	3216
Gibel carp	49	237			286	1898	7289			9187	2023	2845			4868	2605	2287			4891	4808
Lamprey												2			2	4				4	2
Carp		141		3	144	9	21			30	7	10			17		6			6	49
Ruff	196	4082			4278	1088	5623		10	6721	267	10 870			11 137	242	10 093			10 335	8117
Sprat		42			42							8			8	50	30			80	33
Crucian carp	1907	7559		4	9469						409	5703			6112	399	3315			3714	4824
Pikeperch	34	1907		22	1963	35	1543		7	1585	207	465		2	673	61	950			1011	1308
Bream	4	18			22	19	186			205	13	62			75	25	24			49	88
Flounder	13 733	5677		12	19 422	13 957	6255		10	20 222	8974	4076		26	13 076	7861	5280	4050	5	17 195	17 479
Tench	92	94			186	246	46			292	304	191			494	501	260			761	433
Burbot	463	60			523	157	7			164	155	4			159	143	29			171	254
Salmon	63	547			609	85	368			453	70	541			611	63	678			741	603
Sea trout	41	364			405	130	475			605	144	544			688	63	721			784	621
Four-horned sculpin							1			1		1			1						1
Whitefish	19	2096			2115	20	2122			2142	13	3602			3615	5	1281			1286	2289
Sea lamprey	1				1																0
Smelt	567	206			773	1000	413			1413	5308	116			5424	1011	87			1098	2177
Lumpfish							1			1											0
Silver bream	38	404		6	448	273	99		8	380	153	43		22	218	227	205		7	439	371
Stickleback						9				9	40				40						12
Rudd	92	53			145	21				21											42
Herring	15 046	12 728			27 774	1 623 106	13 225			1 636 331	1 357 088	3681			1 360 769	1 555 136	15 626			1 570 761	1 148 908
Ide	71	243		2	316	126	166			292	129	288			417	110	109			219	311
Roach	13 390	8878		28	22 296	11 722	6642		8	18372	10 868	6273	6700	16	23 857	15219	4926	11 400	7	31552	24 019
Dace		12			12											2				2	4
Cod	116	47			163	345	157			502	210	115			324	220	171			391	345
Garfish	16 632	304			16 936	37 305	2401		15	39 721	22 338	164		25	22 527	23 763	122		122	24 007	25 798
Bleak	12				12	6				6	28	10			38						14
Rainbow trout	1	11			12	3	11			14	3	3			6						8
Vimba bream	167	4059		42	4267	151	2962			3113	188	2833			3021	148	3040			3188	3397
Twaite shad	1				1																0
Round goby												0			0						0
Other species	5	10			15																4
Total	76 327	247 422	65	4969	328 783	1 705 121	223 075	65	1661	1 929 922	1 419 106	249 049	6700	1288	1 676 143	1 619 278	231 506	15 450	287	1 866 521	1 450 342

Source: MoA

Table 12. Species composition and catches (kg) of commercial fishing in Pärnu Bay (fishing squares 178–180) broken down by coastal fishing gear, 2007–2010

Species /	2007				2008					2009					2010					2007-2010
Fishing gear	Trap nets	Gill nets	Lon-glines	Total	Trap nets	Gill nets	Seine nets	Lon-glines	Total	Trap nets	Gill nets	Seine nets	Lon-glines	Total	Trap nets	Gill nets	Seine nets	Lon-glines	Total	Average
Perch	232 670	269 849	3743	506 261	243 774	184 705		712	429 190	228 052	277 703	2	159	505 916	301 034	312 067	19	228	613 348	513 679
Eel	184	2	12	198	144			4	148	115				115	72			2	74	134
Eelpout	4			4	60				60	44	3			47	762	3			765	219
Pike	260	270		531	486	950			1436	338	129			466	1035	667			1702	1034
Gibel carp					11 239	7337			18 576		8			8						4646
Lamprey	505			505	17				17	148				148	567				567	309
Carp	12	45	3	60	27	245			272	10	124			134	11	82			93	140
Ruff	6125	1842		7967	7143	1567		5	8715	8719	3706			12 425	12 218	8933			21 151	12 565
Crucian carp	17 334	5870	14	23 217						5404	7818		5	13 227	4724	8810			13 534	12 494
Pikeperch	38 185	56 446	35	94 666	41 849	9089		146	51 084	40 415	24 511		4	64 931	34 119	36 739		82	70 941	70 405
Bream	4966	643		5609	3336	404			3740	2102	309			2411	2031	260			2291	3513
Flounder	641	684	2	1327	691	494	1	1	1186	1202	581			1783	898	689			1587	1471
Tench					3	10			13	1	13			14	2	36			38	16
Burbot	16	7		23	6	2			8	13				13	19	2			21	16
Salmon	14	4		18	32	109			141	44	32			76	29	30			59	73
Sea trout	5	3		8	2	6			8	20				20	13				13	12
Four-horned sculpin						1			1											0
Whitefish	97	993		1090	63	328			391	96	631			727	36	817			853	765
Sea lamprey															31				31	8
Smelt	458 334	6351		464 685	624 103	1558			625 661	717 895	25 675			743 569	404 780	1428			406 208	560 031
Silver bream	25 593	2422		28 015	20 207	2855	12	7	23 081	11265	2302	4		13 570	10 397	2474	3		12 874	19 385
Stickleback															11		5		16	4
Rudd	3			3						7				7						3
Herring	5 734 544	229		5 734 773	8 338 808	277			8 339 085	9 030 925	43			9 030 968	6 328 126	246			6 328 372	7 358 300
Ide	42	6		48	2	6			8		5			5	6	2			8	17
Roach	16 560	2338	2	18 900	9621	1387		9	11 017	9018	1682			10 700	10 544	2131			12 675	13 323
Cod	1			1	9				9		3			3	12	3			15	7
Garfish	2535	120		2655	10 090	100			10 190	14 689	115			14 804	21 168	20			21 188	12 209
Bleak					10				10											3
Vimba bream	20 190	5612		25 801	20 644	4570			25 214	11 182	5223			16 405	16 606	5338			21 944	22 341
Lesser sand eel							80		80											20
Other species	275	39		314																79
Total	880 745	353 774	3811	1 238 330	9 332 365	215 998	93	884	9 549 339	10 081 700	350 615	6	168	10 432 489	7 149 251	380 777	27	311	7 530 366	7 187 631

Source: MoA

BALTIC TRAWLING

Stocks and catches of herring, sprat and cod and future outlooks

Herring, sprat and cod, together with salmon and sea trout, are the 'internationally regulated' fish species regarding which the International Council for the Exploration of the Sea (ICES) issues annual stock assessments and management recommendations for different fishing grounds (divisions), based on the data of researchers from countries on the Baltic Sea.

Herring

Since 2009, herring stocks (as well as sprat stocks) have been assessed in accordance with the methodology of the International Council for the Exploration of the Sea (ICES), while biological material is collected under Commission Regulations No. 199/2008 and No. 949/2008 and Commission Decision 2008/949/EC.

Unlike sprat (which is treated as a single stock unit i.e. population across the Baltic Sea), in the case of herring the state of stocks is assessed and advice for exploitation is given separately for four 'stock units' (Figure 6):

- Baltic Proper herring (subdivisions 25–29 and 32);
- Gulf of Riga herring (subdivision 28-1);
- Bothnian Sea herring (subdivision 30); and
- Bothnian Bay herring (subdivision 31).

The Gulf of Riga and the Bothnian Sea (and possibly also the Bothnian Bay) are inhabited by local natural herring populations, and the stock of the so-called Baltic Proper herring (also Central Baltic herring) in subdivisions 25–29 and 32 contain a number of local populations (e.g. the Gulf of Finland herring and the Swedish coast herring).

Next the stock units of the Baltic Proper and the Gulf of Riga are discussed, as these are of key interest to Estonian fishermen.

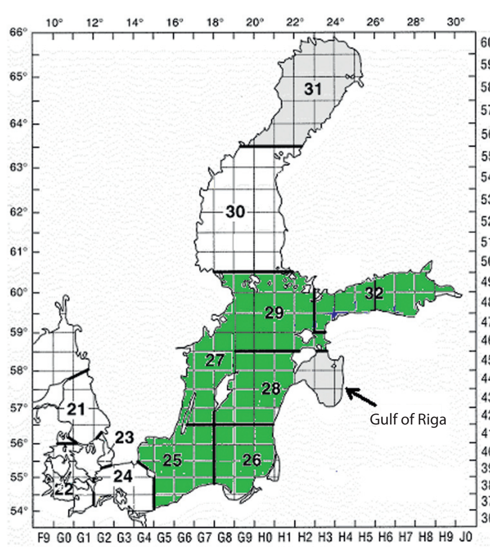


Figure 6.
Agreed stock and management units for herring in Baltic Sea:

- Baltic Proper herring (ICES subdivisions 25–29 and 32; green in figure)
- Gulf of Riga herring (subdivision 28-1)
- Bothnian Sea herring (subdivision 30)
- Bothnian Bay herring (subdivision 31)

Herring in subdivisions 25–29 and 32 (Baltic Proper herring)

In recent years, herring catches from the Baltic Proper have increased from the recession of 2005 (92,000 t) to 137,000 t in 2010. Nevertheless, the average catch of herring taken in this division in recent years still represents just 46% of the average herring catch of the 1980s. Traditionally, Sweden (50,000 t), Poland (25,000 t) and Finland (22,000 t) landed the largest catches in 2010. Estonia's landings amounted to 18,000 t (Table 13).

In terms of tonnes, the most herring was caught in subdivisions 28-2 and 25 (33,000 t and 26,000 t respectively), while subdivisions 29, 28-2 and 32 dominated in terms of numbers. This can be explained by geographical differences in the mean body weight of herring (Figure 7).

Table 13. Herring in subdivisions 25–29 and 32: catches by country (10^3 t) (ICES, 2011)

Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	Total
1977	11.9		33.7	0.0			57.2	112.8	48.7	**264.3**
1978	13.9		38.3	0.1			61.3	113.9	55.4	**282.9**
1979	19.4		40.4	0.0			70.4	101.0	71.3	**302.5**
1980	10.6		44.0	0.0			58.3	103.0	72.5	**288.4**
1981	14.1		42.5	1.0			51.2	93.4	72.9	**275.1**
1982	15.3		47.5	1.3			63.0	86.4	83.8	**297.3**
1983	10.5		59.1	1.0			67.1	69.1	78.6	**285.4**
1984	6.5		54.1	0.0			65.8	89.8	56.9	**273.1**
1985	7.6		54.2	0.0			72.8	95.2	42.5	**272.3**
1986	3.9		49.4	0.0			67.8	98.8	29.7	**249.6**
1987	4.2		50.4	0.0			55.5	100.9	25.4	**236.4**
1988	10.8		58.1	0.0			57.2	106.0	33.4	**265.5**
1989	7.3		50.0	0.0			51.8	105.0	55.4	**269.5**
1990	4.6		26.9	0.0			52.3	101.3	44.2	**229.3**
1991	6.8	27.0	18.1	0.0	20.7	6.5	47.1	31.9	36.5	**194.6**
1992	8.1	22.3	30.0	0.0	12.5	4.6	39.2	29.5	43.0	**189.2**
1993	8.9	25.4	32.3	0.0	9.6	3.0	41.1	21.6	66.4	**208.3**
1994	11.3	26.3	38.2	3.7	9.8	4.9	46.1	16.7	61.6	**218.6**
1995	11.4	30.7	31.4	0.0	9.3	3.6	38.7	17.0	47.2	**189.3**
1996	12.1	35.9	31.5	0.0	11.6	4.2	30.7	14.6	25.9	**166.7**
1997	9.4	42.6	23.7	0.0	10.1	3.3	26.2	12.5	44.1	**172.0**
1998	13.9	34.0	24.8	0.0	10.0	2.4	19.3	10.5	71.0	**185.9**
1999	6.2	35.4	17.9	0.0	8.3	1.3	18.1	12.7	48.9	**148.7**
2000	15.8	30.1	23.3	0.0	6.7	1.1	23.1	14.8	60.2	**175.1**
2001	15.8	27.4	26.1	0.0	5.2	1.6	28.4	15.8	29.8	**150.2**
2002	4.6	21.0	25.7	0.3	3.9	1.5	28.5	14.2	29.4	**129.1**
2003	5.3	13.3	14.7	3.9	3.1	2.1	26.3	13.4	31.8	**113.8**
2004	0.2	10.9	14.5	4.3	2.7	1.8	22.8	6.5	29.3	**93.0**
2005	3.1	10.8	6.4	3.7	2.0	0.7	18.5	7.0	39.4	**91.6**
2006	0.1	13.4	9.6	3.2	3.0	1.2	16.8	7.6	55.3	**110.4**
2007	1.4	14.0	13.9	1.7	3.2	3.5	19.8	8.8	49.9	**116.0**
2008	1.2	21.6	19.1	3.4	3.5	1.7	13.3	8.6	53.7	**126.2**
2009	1.5	19.9	23.3	1.3	4.1	3.6	18.4	12	50.2	**134.1**
2010	5.4	17.9	21.6	2.2	3.9	1.5	25.0	9.1	50.0	**136.7**

The average age composition of herring catches has been quite unvaried over time: catches are dominated by age groups 1–3, which represent nearly 60% of catches. This can be explained by the domination of pelagic cohorts mainly composed of younger herring in trawl catches (Figure 8). Unlike sprat, greater stability of age composition has been observed in herring catches which is due to a smaller variation in the abundance of herring year classes.

The mean body weight of herring has decreased significantly over the past 20–25 years throughout the Baltic Sea, accounting for just 40–50% of the weight level of the 1970s and 1980s in the age groups that are more abundant today. The mean body weight has been stabilising since the period 2006–2008 (Figure 9).

In 2008 and 2009 the ICES made a significant downward correction to its earlier assessment of this stock unit (as well as of sprat). The reason for this was

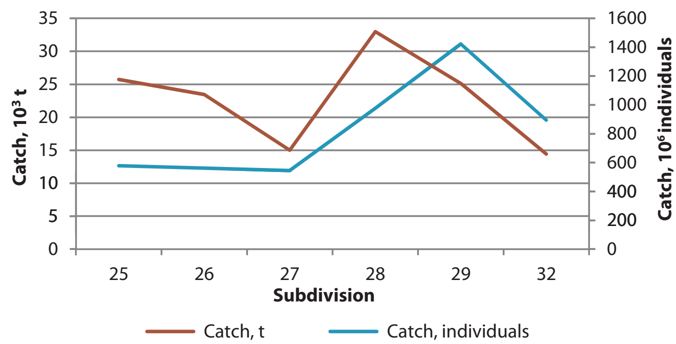


Figure 7. Herring in subdivisions 25–29 and 32: herring catches in tonnes (10^3 t) and numbers (million individuals) in 2010 (ICES, 2011).

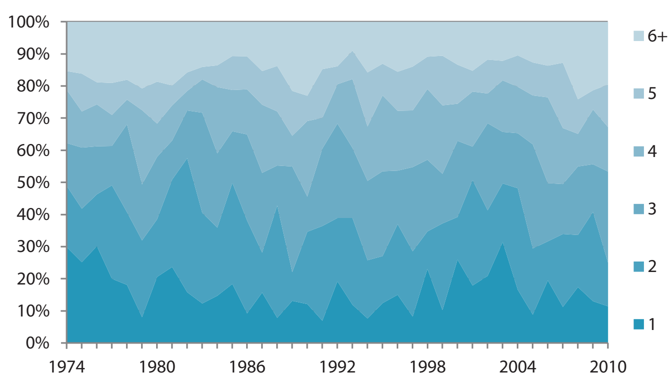


Figure 8. Herring in subdivisions 25–29 and 32: average age composition of catches from 1974–2010 (ICES, 2011).

1: 1-year-olds
2: 2-year-olds etc.
6+: 6-year-olds and older individuals

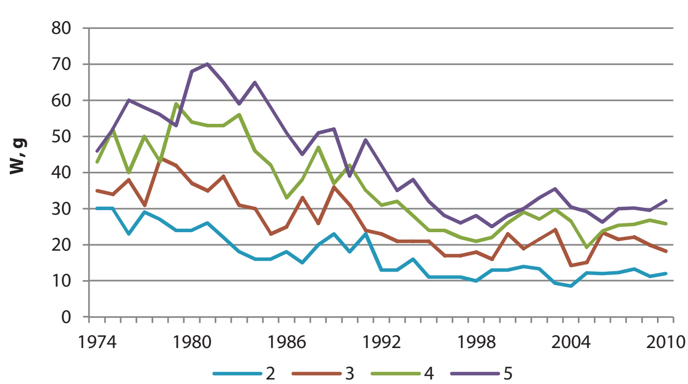


Figure 9. Herring in subdivisions 25–29 and 32: dynamics of mean body weight of herrings at ages 2–5 years in 1974–2010 (ICES, 2011).

a substantial change in the acoustic estimate of the stock. The trend of the stock was not changed vis-à-vis the previous one as a result of the correction, but implies significantly lower levels. According to the latest estimate, the spaw stock biomass of herring in the Baltic Proper amounted to 535,000 t at the begin of 2011, which is 60% lower than the 1974–2010 average (Figure 10). This low biomass is explained by low mean body weight on the one hand, and by lower abundance of recent year classes on the other. Indeed, no abundant herring year classes have occurred since 2002 (and even the year class of 2002 was only slightly more abundant than the long-term average). Of later year classes, only that of 2007 was slightly above average (Figure 11). Therefore, in recent years the stocks have increased mainly as a result of the decline of fishing mortality to a record low level in the first half of the 2000s. The outlook for the coming years depends on the actual abundance of the cohorts of 2008–2010, which will account for most of the catch in 2012 and 2013 when they will be 2–5 years of age.

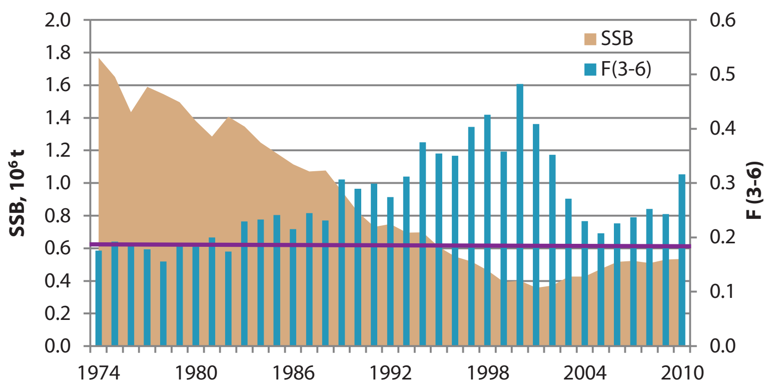


Figure 10. **Herring in subdivisions 25–29 and 32: spaw stock biomass (SSB) and fishing mortality in age groups 3–6 (F_{3-6}), 1974–2010. The horizontal line in the graph represents the maximum sustainable exploitation intensity F_{PA} = 0.19 (ICES, 2011).**

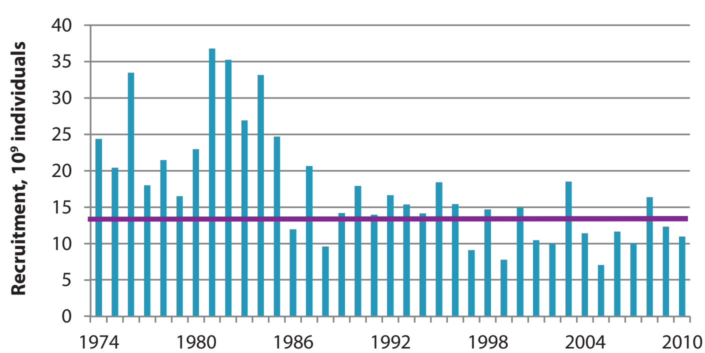


Figure 11. **Herring in subdivisions 25–29 and 32: dynamics of abundance of recruitment (1-year-olds). The horizontal line marks the long-term average (ICES, 2011).**

Central Baltic herring stock status is assessed against of two reference levels of fishing mortality. These are the 'precautionary fishing mortality rate' F_{PA} = 0.19 (the maximum fishing mortality rate that can be implemented without directly endangering recruitment, but which should be avoided in accordance with responsible fishing principles) and F_{MSY} = 0.16 (which enables maximum catches to be taken in the long run without endangering stocks). Unfortunately, actual fishing mortality has exceeded both levels since 1983. The situation was particularly bad in the years 1994–2002, when the actual fishing mortality exceeded the recommended level by more than twice (Figure 10). Due to the high mortality rate, the exploitation of herring stocks in the Central Baltic Sea cannot be deemed sustainable. This means that recommended fishing quotas are not expected to increase until fishing mortality has fallen to the levels mentioned above.

According to the advice of the working groups that assess the Baltic Sea herring stocks, herring fishing volumes should be further limited. Therefore, the total allowable catch is likely to limit fishing in 2011 and 2012.

Gulf of Riga herring

The Gulf of Riga herring is caught by Estonian and Latvian fishermen, with the share of Latvia's catches accounting for 60–70% in recent decades. Both Estonia's and Latvia's herring catches from the Gulf of Riga were relatively stable from 2008–2010 and corresponded to catch quotas (Table 14). According to Latvian

Table 14. Gulf of Riga herring: Estonian, Latvian and unreported landings, 1991–2010 (ICES, 2011)

Year	Estonia	Latvia	Unreported (Latvia)	Total
1991	7420	13 481	–	**20 901**
1992	9742	14 204	–	**23 946**
1993	9537	13 554	3446	**26 537**
1994	9636	14 050	3512	**27 198**
1995	16 008	17 016	3401	**36 425**
1996	11 788	17 362	3473	**32 623**
1997	15 819	21 116	4223	**41 158**
1998	11 313	16 125	3225	**30 663**
1999	10 245	20 511	3077	**33 833**
2000	12 514	21 624	3244	**37 382**
2001	14 311	22 775	3416	**40 502**
2002	16 962	22 441	3366	**42 769**
2003	19 647	21 780	3267	**44 694**
2004	18 218	20 903	3136	**42 257**
2005	11 213	19 741	2961	**33 915**
2006	11 924	19 186	2878	**33 988**
2007	12 764	19 425	2914	**35 103**
2008	15 877	19 290	1929	**37 096**
2009	17 167	19 069	1907	**38 143**
2010	15 422	17 751	1775	**34 948**

researchers, a significant part of Latvian herring catches is not reflected in official statistics. In recent years this has been estimated to be up to 10% of the official catch, and previously even up to 20%.

In addition to 'local' gulf herring, catches also include the Baltic Proper herring that prefers to spawn in the Gulf of Riga, whereas both varieties come under a single catch quota. The share of the Baltic Proper herring in the herring catch taken from the Gulf of Riga has been less than 5% in recent years.

The long-term age structure of herring catches from the Gulf of Riga is generally similar to that of the Central Baltic herring catches. The only difference is the greater variation in the abundance of the Gulf of Riga year classes (Figure 12).

Similar to the Central Baltic herring, the weight of the Gulf of Riga herring has decreased significantly from the record levels of the begin of the 1980s (Figure 13).

The herring stocks of the Gulf of Riga have been in a relatively good state since the 1990s, and spaw stock biomass is about twice the level of the 1970s

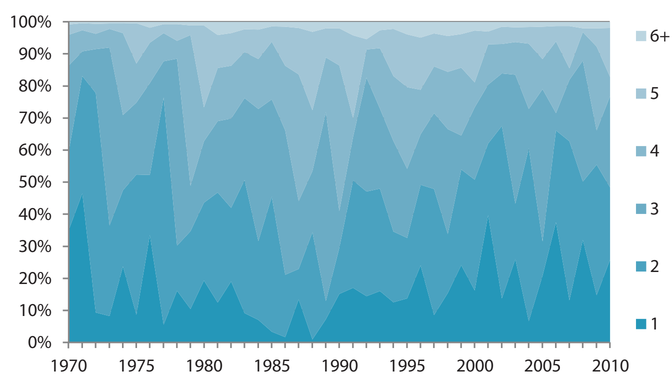


Figure 12. Gulf of Riga herring: average age composition of catches from 1974–2010 (ICES, 2011)
1: 1-year-olds, 2: 2-year-olds etc., 6+: 6-year-olds and older individuals

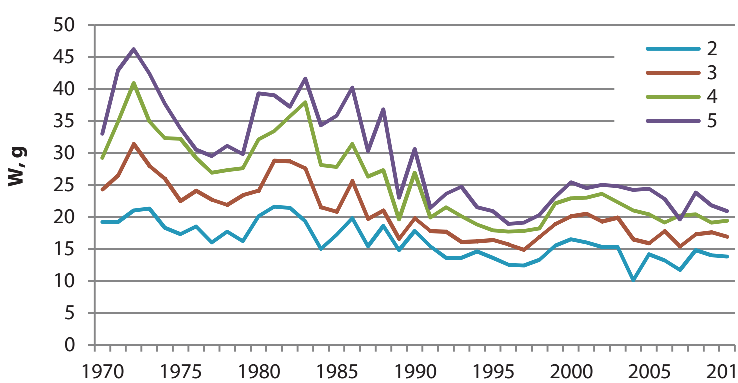


Figure 13. Gulf of Riga herring: dynamics of mean body weight of 2–5-year-old herrings from 1970–2010 (ICES, 2011)

(Figure 14). The good state of the Gulf of Riga herring stock in the last two decades is mostly due to the abundance of new year classes, which has been high in the last two decades, unlike in the Baltic Proper. Only the cohorts that appeared after the cold winters of 1996, 2003 and 2006 were moderate or weaker than the long-term average in the Gulf of Riga (Figure 15). The year-class strength of the Gulf of Riga herring seems to be strongly influenced by the severity of winter and the abundance of zooplankton in spring, which determine the feeding conditions of juveniles in spring and thus also their survival.

Hence, the many mild winters in the last decade have obviously been favourable for the reproduction of Gulf of Riga herring. The spaw stock biomass of herring in the gulf decreased slightly from 2004–2006. However, the SSB stabilised thanks to the rich year classes of 2005 and 2007, exceeding the long-term average by 19% at the begin of 2011 (SSB_{2010} 76,800 t). The dynamics of herring catches from the Gulf of Riga have been similar to that of the spaw stock biomass: the catches have ranged between 30,000 and 40,000 t since the second half of the 1990s, which is two times higher than in the 1970s and 1980s (ICES, 2011).

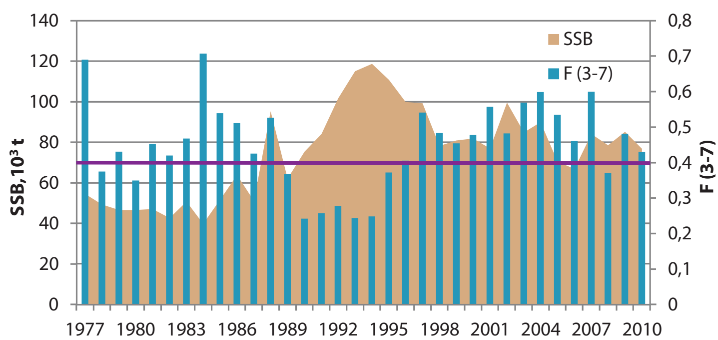


Figure 14. Gulf of Riga herring: spaw stock biomass (SSB) and fishing mortality in age groups 3–7 (F_{3-7}), 1977–2010. The horizontal line in the graph represents the maximum sustainable exploitation intensity F_{PA} = 0.4 (ICES, 2011)

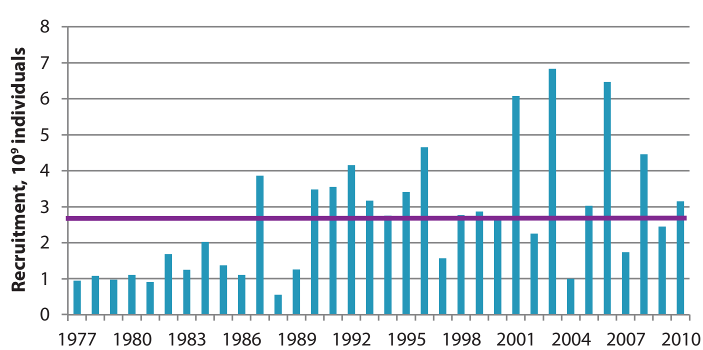


Figure 15. Gulf of Riga herring: dynamics of abundance of recruitment (1-year-olds). The horizontal line marks the long-term average (ICES, 2011)

Excessively high fishing mortality has been a concern in the management of the Gulf of Riga herring, just as in the case of the Central Baltic herring. This phenomenon can probably be explained by both the dynamics of body weight and the fact that some landings are not reported (it is estimated that 10–20% of Latvia's landings remain unreported, Table 14).

Like, the Central Baltic herring, the status of the Gulf of Riga herring stock is also assessed against the two reference levels of fishing mortality mentioned above. Unfortunately, the long-term dynamics of fishing mortality rates indicates that, despite the high biomass of the Gulf of Riga herring, fishing mortality has exceeded these levels since 1997 (Figure 14). Thus, recommended fishing quantities are not expected to increase for Gulf of Riga herring in the next few years.

The state of both the Central Baltic herring and the Gulf of Riga herring stocks may improve if sprat stocks decrease, as this would lead to a decrease in food competition between sprat and herring and an increase in the mean body weight of herring. This might cause a much faster reduction of the fishing mortality of both stock units, which in turn would create preconditions for increased fishing opportunities.

Sprat

Although sprat, like herring, is a pelagic fish, it is still biologically a quite different species. The main difference lies in the high fecundity and the pelagic spaw of sprat (sprat roe develops while floating in water, whereas herring spawns on benthic vegetation). These factors lead to a remarkable variation in the reproduction of sprat, which depends on the environmental conditions prevailing in the year in question. The main spaw grounds of sprat in the Baltic Sea are located on the slopes of the Bornholm and Gotland Deeps. In periods when sprat abundance is high, sprat move out of these reproduction centres (which are characterised by optimal environmental conditions for the sprat) and spread throughout the Baltic Sea, except in freshwater areas in the Bothnian Bay and the eastern part of the Gulf of Finland. Sprat are also present in the Gulf of Riga in low numbers. An important factor influencing the state of sprat stocks is the abundance of its main natural enemy – the cod. During periods when cod abundance is high, there are few sprat in the Baltic Sea and vice versa.

The large variability in the abundance and biomass of sprat is also reflected in the dynamics of the total catch of sprat, which has varied over the last 33 years from 37,000 t in 1983 to 589,000 t in 1997 (Table 15). From 2006 to 2010 the catches of Baltic sprat ranged from 340,000 to 407,000 t. In 2010, 342,000 t of sprat were caught. Sweden (21%), Poland (17%), Estonia (14%) and Denmark (13%) have landed the largest catches in recent years.

The stock and age composition of sprat is characterised by the dominance of younger age groups: age groups 1–2 account for 40–80% of catches, depending on the abundance of new cohorts (Figure 16).

The dynamics of the body weight of sprat has generally followed the corresponding trend of herring in recent decades. However, the decline in the body weight of sprat has been significantly lower compared to herring, and the mean

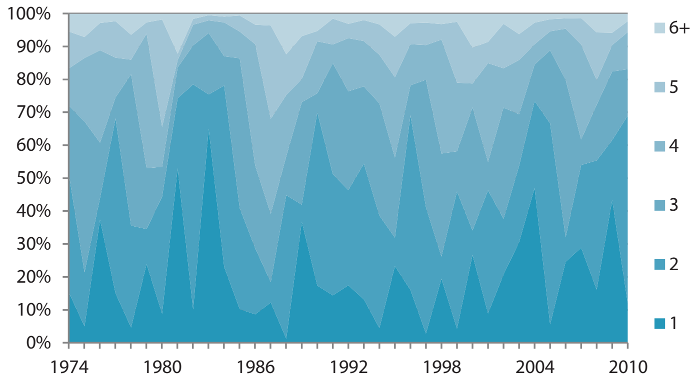


Figure 16. Average age composition of sprat catches from 1974–2010 (ICES, 2011)

1: 1-year-olds
2: 2-year-olds etc.
6+: 6-year-olds and older individuals

Table 15. Sprat catches in Baltic Sea from 1977–2010, 10^3 t (ICES, 2011)

Year	Denmark	Estonia	Finland	GDR	FRG	Latvia	Lithuania	Poland	Sweden	Russia*	Total
1977	7.2		6.7	17.2	0.8			38.8	0.4	109.7	**180.8**
1978	10.8		6.1	13.7	0.8			24.7	0.8	75.5	**132.4**
1979	5.5		7.1	4.0	0.7			12.4	2.2	45.1	**77.0**
1980	4.7		6.2	0.1	0.5			12.7	2.8	31.4	**58.4**
1981	8.4		6.0	0.1	0.6			8.9	1.6	23.9	**49.5**
1982	6.7		4.5	1.0	0.6			14.2	2.8	18.9	**48.7**
1983	6.2		3.4	2.7	0.6			7.1	3.6	13.7	**37.3**
1984	3.2		2.4	2.8	0.7			9.3	8.4	25.9	**52.7**
1985	4.1		3.0	2.0	0.9			18.5	7.1	34.0	**69.6**
1986	6.0		3.2	2.5	0.5			23.7	3.5	36.5	**75.9**
1987	2.6		2.8	1.3	1.1			32.0	3.5	44.9	**88.2**
1988	2.0		3.0	1.2	0.3			22.2	7.3	44.2	**80.2**
1989	5.2		2.8	1.2	0.6			18.6	3.5	54.0	**85.9**
1990	0.8		2.7	0.5	0.8			13.3	7.5	60.0	**85.6**
1991	10.0		1.6		0.7			22.5	8.7	59.7	**103.2**
1992	24.3	4.1	1.8		0.6	17.4	3.3	28.3	54.2	8.1	**142.1**
1993	18.4	5.8	1.7		0.6	12.6	3.3	31.8	92.7	11.2	**178.1**
1994	60.6	9.6	1.9		0.3	20.1	2.3	41.2	135.2	17.6	**288.8**
1995	64.1	13.1	5.2		0.2	24.4	2.9	44.2	143.7	14.8	**312.6**
1996	109.1	21.1	17.4		0.2	34.2	10.2	72.4	158.2	18.2	**441.0**
1997	137.4	38.9	24.4		0.4	49.3	4.8	99.9	151.9	22.4	**529.4**
1998	91.8	32.3	25.7		4.6	44.9	4.5	55.1	191.1	20.9	**470.9**
1999	90.2	33.2	18.9		0.2	42.8	2.3	66.3	137.3	31.5	**422.7**
2000	51.5	39.4	20.2		0.0	46.2	1.7	79.2	120.6	30.4	**389.2**
2001	39.7	37.5	15.4		0.8	42.8	3.0	85.8	85.4	32.0	**342.4**
2002	42.0	41.3	17.2		1.0	47.5	2.8	81.2	77.3	32.9	**343.2**
2003	32.0	29.2	9.0		18.0	41.7	2.2	84.1	63.4	28.7	**308.3**
2004	44.3	30.2	16.6		28.5	52.4	1.6	96.7	78.3	25.1	**373.7**
2005	46.5	49.8	17.9		29.0	64.7	8.6	71.4	87.8	29.7	**405.2**
2006	42.1	46.8	19.0		30.8	54.6	7.5	54.3	68.7	28.2	**352.1**
2007	37.6	51.0	24.6		30.8	60.5	20.3	58.7	80.7	24.8	**388.9**
2008	45.9	48.6	24.3		30.4	57.2	18.7	53.3	81.1	21.0	**380.5**
2009	59.7	47.3	23.1		26.3	49.5	18.8	81.9	75.3	25.2	**407.1**
2010	43.6	47.9	24.4		17.8	45.9	9.2	56.7	70.4	25.6	**341.5**

* Soviet Union until 1991

body weight of sprats of the same age currently accounts for approximately 70% of the body weight in the first half of the 1980s (Figure 17).

Sprat in the Baltic Sea is treated as a single stock unit and therefore a single total allowable catch (TAC) is specified for sprat which covers the entire Baltic Sea.

From the second half of the 1980s, simultaneously with a decline in the abundance of cod, the abundance and biomass of sprat began to increase rapidly, reaching 3 million tonnes in 1995 (with spaw stock biomass amounting to 1.4 million tonnes). Thanks to the rich year classes of 1994 and 1995, the SSB of sprat reached a record level of 1.7 million tonnes in 1997 and 1998.

From then on, a downward trend of the SSB has been observed. In 2010 the SSB was estimated to amount to 891,000 t, which is 6% higher than the long-term average (Figures 18 and 19). The decline in the spaw stock biomass was caused by weak year classes of 2004, 2007 and 2009, as well as high fishing mortality. Recent acoustic surveys show that stocks have declined mainly in the southern part of the Baltic Sea and that stocks have relocated to the northern part of the sea to a considerable extent. Thus, at present, the status of the sprat stock in the EEZ of Estonia can still be regarded as satisfactory.

However, it should be noted that despite the relatively high abundance of sprat stocks in Estonian waters, fishing prospects still depend on the general situation of stocks in the Baltic Sea. Also, the location of sprat stocks depends heavily on the hydrological conditions prevailing in the year in question.

ICES classifies the sprat stocks of the Baltic Sea as being at risk of non-sustainable exploitation due to high fishing mortality ($F_{2008–2010} = 0.46$), which exceeds both the precautionary mortality rate ($F_{PA} = 0.4$) and the maximum fishing mortality for sustainable yield ($F_{MSY} = 0.35$) (Figure 18).

Given that the year classes 2007 and 2009 are weak, the stocks and catches of sprat are currently largely dependent on the cohort of 2008, which according to the assessment made in 2011 is around twice as strong as the long-term average and accounted for 55% of catches in 2010 (ICES, 2011).

It should be noted, however, that stocks and catches relying on just one abundant year class cannot be sustainable in the long run. As sprat stocks are extremely dependent on recruitment, any assessment of the prospects of stocks is plagued by considerable uncertainties. For example, the cohorts of 2011 and 2012, whose abundance can only be guessed at present, will account for as much as 55% of spaw stock biomass in 2013. The actual abundance of these cohorts will not be clear until 2012 and 2013.

As sprat is a major food item for the main predatory fish in the Baltic Sea (the cod), the prospects of sprat stocks are undoubtedly influenced by the dynamics of cod abundance.

Figure 20 compares the average natural mortality of sprat in the age groups 1–6, and the spawning stock biomass of Eastern Baltic cod from 1974–2010. The interdependence depicted allows for the statement that an increase in the spaw stock biomass of cod by 100,000 t over the period has, theoretically, increased the natural mortality of sprat by 25%.

Since 1994 the total mortality of sprat has mostly been influenced by fishing mortality. Natural mortality prevailed in the total mortality of sprat from 1978–

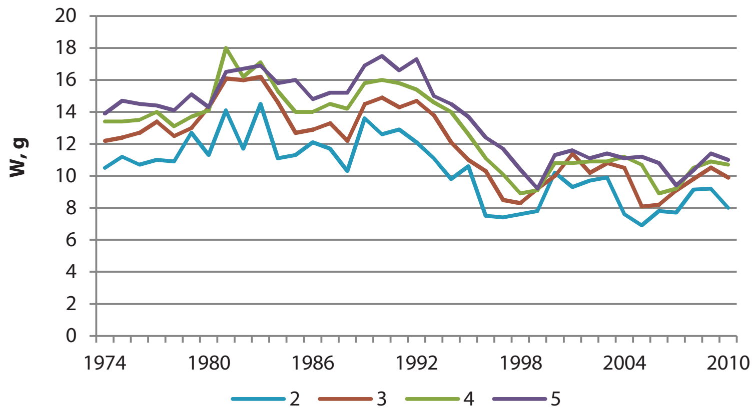


Figure 17. **Dynamics of mean body weight of 2–5-year-old sprats from 1974–2010 (ICES, 2011)**

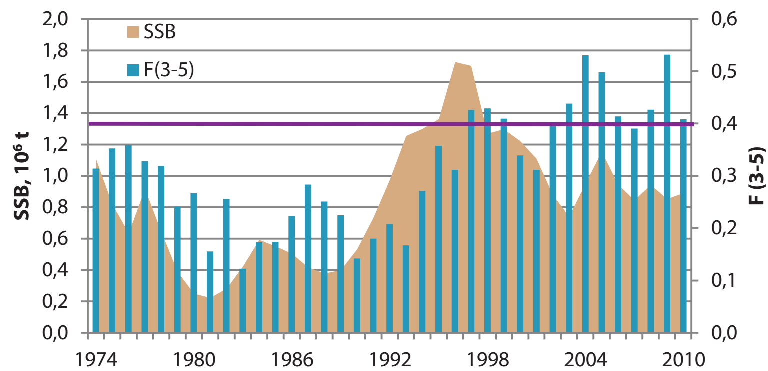


Figure 18. **Sprat spaw stock biomass (SSB) and fishing mortality in age groups 3–5 (F_{3-5}), 1974–2010. The horizontal line in the graph represents the maximum sustainable exploitation intensity $F_{PA} = 0.4$ (ICES, 2011).**

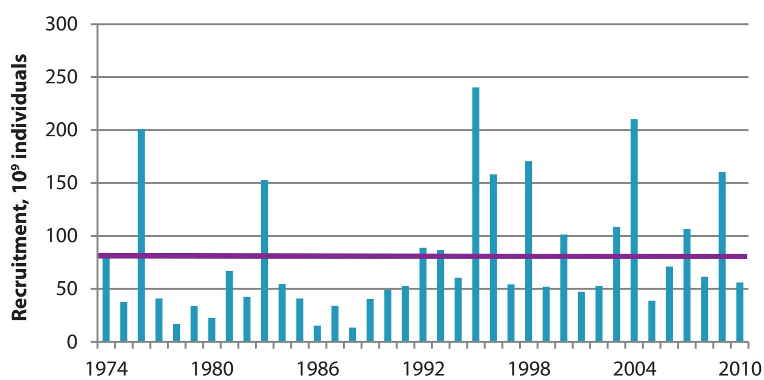


Figure 19. **Dynamics of sprat recruitment (1-year-olds) from 1974–2010. The horizontal line marks the long-term average (ICES, 2011).**

Figure 20. Estimate of natural mortality of sprat in age groups 1–6 at different levels of Eastern Baltic cod spawning stock biomass from 1974–2010 (data: ICES)

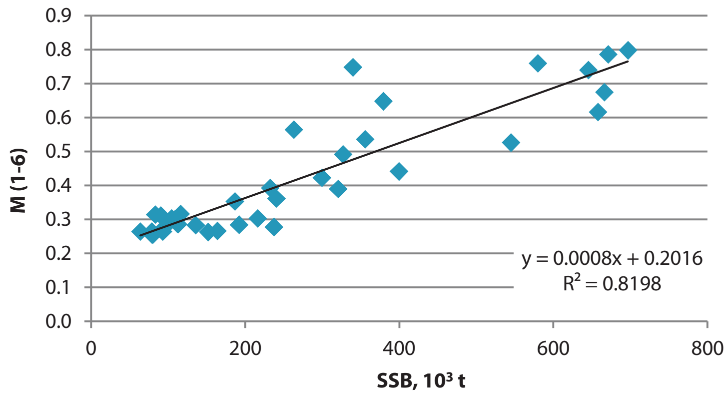
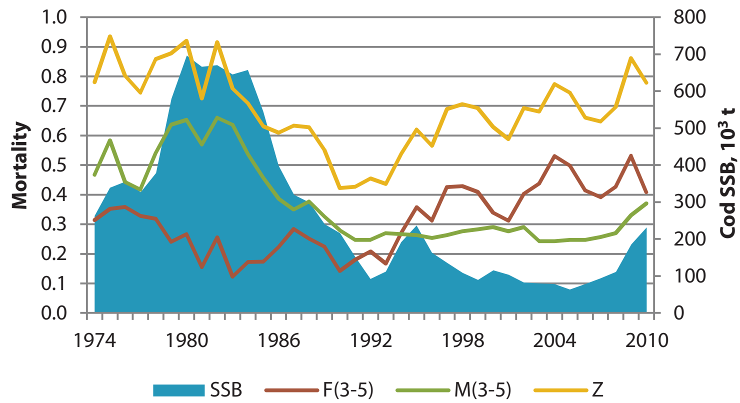


Figure 21. Fishing mortality ($F_{3–5}$), natural mortality ($M_{3–5}$) and total mortality ($Z_{3–5}$) of sprat and spawning stock biomass (SSB) of Eastern Baltic cod from 1974–2010 (data: ICES)



1986, when the spaw stock biomass of cod was above 300,000 t (currently 250,000 t, Figure 21). This shows that with current cod stock levels the key to the management of sprat stocks still lies in influencing the fishing mortality of sprat.

According to the recommendation of the ICES, the maximum total catch of sprat in 2011 and 2012 should not exceed 242,000 t.

Cod (in subdivisions 25–32 i.e. Eastern Baltic cod)

The distribution and abundance of cod as a marine fish species depend on the existence of suitable reproduction conditions in the Baltic Sea. The main spaw grounds of cod are located on the slopes of the Bornholm, Gdansk and Gotland Deeps. The environmental conditions of the Baltic Sea are generally not conducive to wide distribution of cod. However, subject to the availability of favourable salinity, oxygen and temperature conditions, the abundance of cod (similar to that of sprat) may increase rapidly thanks to the cod's high fecundity.

Cod stocks have remained at low levels in the eastern part of the Baltic Sea since the 1990s. The ICES estimates that the long-term recession of the Eastern

Baltic cod stocks has been caused by low reproduction (due to unfavourable environmental conditions, in particular in the Gotland Deep), and excessive, often uncontrolled, fishing, especially in the 2000s (Table 16).

Thanks to the year classes 2006–2008, which nevertheless still fell significantly below of the long-term average (Figure 22), the abundance and spaw stock biomass of the Eastern Baltic cod have increased slightly in recent years, amounting to 308,000 t at the begin of 2011, when it exceeded the long-term average (265,000 t) (Figure 23).

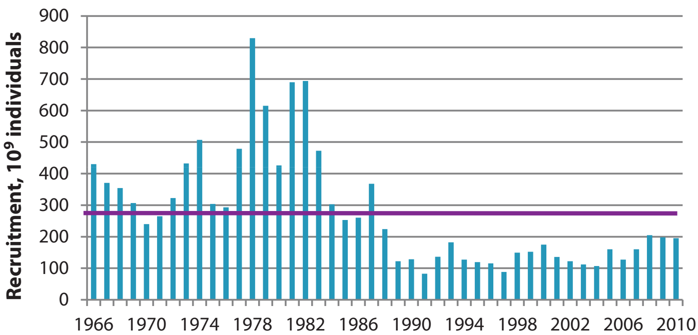


Figure 22. Eastern Baltic cod: dynamics of abundance of recruitment (2-year-olds), 1966–2010. The horizontal line marks the long-term average (ICES, 2011).

Table 16. Catches of Eastern Baltic cod from 1992–2010, t (ICES, 2011)

Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	Unreported	Total
1992	18 025	1368	485	2793	1250	1266	13 314	1793	13 995	0	**54 882**
1993	8000	70	225	1042	1333	605	8909	892	10 099	18 978	**50 711**
1994	9901	952	594	3056	2831	1887	14 335	1257	21 264	44 000	**100 856**
1995	16 895	1049	1729	5496	6638	4513	25 000	1612	24 723	18 993	**107 718**
1996	17 549	1338	3089	7340	8709	5524	34 855	3306	30 669	10 815	**124 189**
1997	9776	1414	1536	5215	6187	4601	31 396	2803	25 072	0	**88 600**
1998	7818	1188	1026	1270	7765	4176	25 155	4599	14 431	0	**67 428**
1999	12 170	1052	1456	2215	6889	4371	25 920	5202	13 720	0	**72 995**
2000	9715	604	1648	1508	6196	5165	21 194	4231	15 910	23 118	**89 289**
2001	9580	765	1526	2159	6252	3137	21 346	5032	17 854	23 677	**91 328**
2002	7831	37	1526	1445	4796	3137	15 106	3793	12 507	17 562	**67 740**
2003	7655	591	1092	1354	3493	2767	15 374	3707	11 297	22 147	**69 476**
2004	7394	1192	859	2659	4835	2041	14 582	3410	12 043	19 563	**68 578**
2005	7270	833	278	2339	3513	2988	11 669	3411	7740	14 991	**55 032**
2006	9766	616	427	2025	3980	3200	14 290	3719	9672	17 836	**65 532**
2007	7280	877	615	1529	3996	2486	8599	3383	9660	12 418	**50 843**
2008	7374	841	670	2341	3990	2835	8721	3888	8901	2673	**42 235**
2009	8295	623		3665	4588	2789	10 625	4482	10 182	3189	**48 439**
2010	10 739	796	826	3908	5001	3140	11 433	4264	10 169		**50 277**

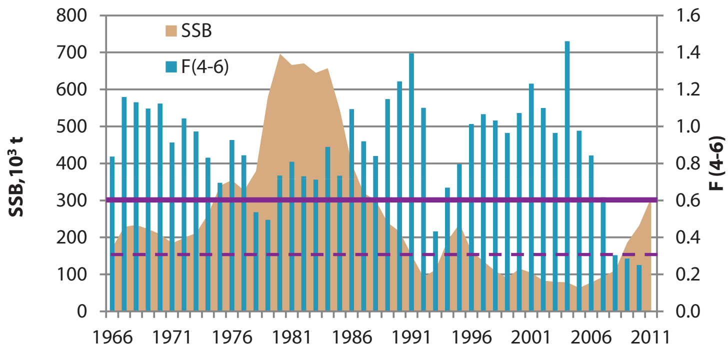


Figure 23. **Eastern Baltic cod: spaw stock biomass (SSB) and fishing mortality in age groups 4–6 (F_{4-6}), 1966–2010. The horizontal solid line in the graph represents the maximum sustainable exploitation intensity F_{PA}= 0.6 and the dotted line marks the target level F_{MGT} = F_{MSY} = 0.3 set in the international management plan (ICES, 2011).**

According to the latest assessments, the ICES regards the exploitation of Eastern Baltic cod as sustainable, since fishing mortality has remained below the target level set in the international management plan (0.3) over the last two years.

The catch of 2010 amounted to 50,000 t (42,000 t in 2008 and 48,000 t in 2009, Table 16).

There is still no commercial cod resource in Estonian waters, and directed fishing for cod is not economically feasible. However, Estonian vessels fish for cod in the Southern Baltic in small quantities. In 2010 the TAC for the Eastern Baltic cod (EU + Russia) was 56,100 t. Estonian fishermen caught 797 t. The total allowable catch of 2011 amounts to 64,500 t. The improvement in the state of cod stocks in recent years would allow higher quotas to be allocated. However, this is not possible because of the Multi-annual Management Plan established by the European Union according to which cod quotas may be increased by not more than 15% per year. Thus, the total allowable catch of 2012 is likely to be 74,200 t.

ESTONIA'S TRAWL FLEET IN THE BALTIC SEA

General overview of sector

In 2010, catches were reported for a total of 48 trawlers with a combined main engine capacity of 12,851 kW and a combined gross tonnage of 4967 t. The average age of the vessels was 26 years. Compared to 2005, the number of trawlers engaged in fishing decreased by 37 vessels or 43% (Figure 24). The number of people employed on trawlers has more than halved, from 466 in 2005 to 227 in 2010.

From 2006–2010, Estonia's sprat fishing opportunities decreased from 51,061 t to 43,522 t. Herring fishing opportunities decreased from 33,442 t to 31,007 t (Figure 25).

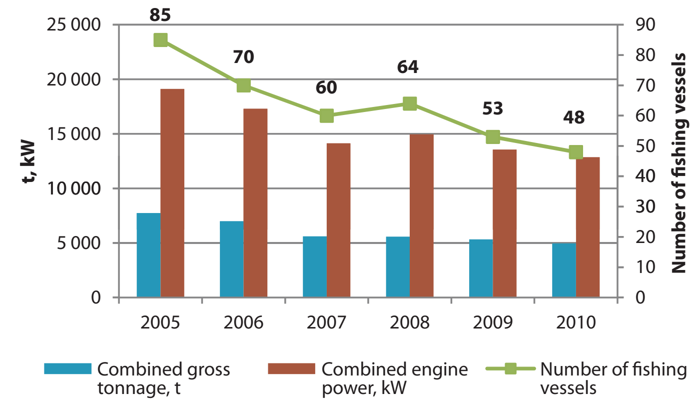


Figure 24. **Number (units), combined gross tonnage (t) and combined power of main engines (kW) of fishing vessels engaged in fishing from 2005–2010.** Source: MoA

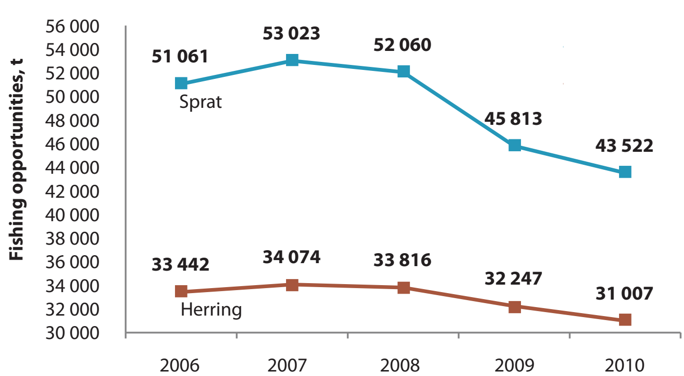


Figure 25. **Estonia's sprat and herring fishing opportunities from 2006–2010.** Source: MoE

In 2010 the historical fishing rights to catch sprat, herring and cod in the Baltic Sea on the basis of fishing vessels' fishing permits were distributed between 28, 29 and 10 companies respectively. The total catch of Estonian trawlers in the Baltic Sea amounted to 68,300 t in 2010. Based on average first sale prices, the value of the catch was 10 million euros. As for species, sprat and herring prevailed in catches, but small amounts of cod, smelt and flounder were caught as well (Figure 26). The share of trawlers in the total catch of Estonia from the Baltic Sea amounted to 86% in 2010.

Sprat and herring were landed mainly at Estonian ports (Table 17) where the catch was sold to fish freezing or processing companies in cases where the fishing company itself was not engaged in the processing and marketing of fish. Estonian trawlers landed fish at 12 Estonian ports (Table 18). At two of them – Veere and Paldiski – the landings exceeded 10,000 t. All in all nearly 40% of the fish brought to Estonian ports by Estonian trawlers was brought ashore at Veere and Paldiski. Most of the sprat and herring catch landed by the Estonian trawl fleet in 2010 were sold on the eastern market (Russia, Ukraine etc.) in frozen form. Cod was landed and sold at foreign ports (Poland, Sweden and Denmark), unlike sprat and herring.

2010 was a difficult year for many fishing companies, as operating costs increased in comparison with 2009. This was mainly due to rising prices of fuel, repair materials and services. Furthermore, sales revenue could not be increased, because fishing quotas and first sale prices remained low.

Within the scope of fisheries subsidies, nearly 1.4 million euros was paid to fishing companies in 2010 for permanent cessation of fishing activities by scrapping or permanent reassignment of fishing vessels. In addition, 617,000 euros was paid for investments on board fishing vessels.

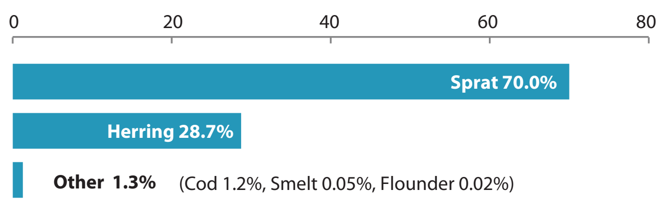


Figure 26. Share of different fish species caught from Baltic Sea in catches of Estonian vessels in 2010. Source: MoA

Table 17. Landings (t) in different countries of fish caught from Baltic Sea by Estonian trawlers in 2010

Country	Sprat	Herring	Cod	Smelt	Flounder	Total
Estonia	47 698	18 007		35		**65 740**
Latvia	163	1610		<1		**1773**
Poland			479		15	**494**
Sweden	<1	9	195			**204**
Denmark			3			**3**

Source: MoA

Table 18. Landings (t) in Estonian ports of fish caught from Baltic Sea by Estonian trawlers in 2010

County	Port of landing	Landings, t	% of total landings of trawlers
Saare	Veere	13 393	20.37
Harju	Paldiski	12 068	18.36
Harju	Miiduranna	9139	13.90
Lääne	Dirhami	7357	11.19
Lääne	Haapsalu	6274	9.54
Harju	Meeruse	4872	7.41
Saare	Saaremaa	2893	4.40
Lääne	Virtsu	2863	4.35
Saare	Roomassaare	1764	2.68
Hiiu	Lehtma	1763	2.68
Harju	Leppneeme	1191	1.81
Saare	Mõntu	837	1.27
Ida-Viru	Toila	767	1.17
Pärnu	Pärnu	255	0.39
Pärnu	Kihnu	174	0.26
Harju	Tapurla	65	0.10
Lääne-Viru	Vergi	40	0.06
Pärnu	Munalaiu	23	0.04

Source: MoA

According to Commission Decision 2008/949/EC, which lays down a Community programme for collection of data in the fisheries sector, Estonia's Baltic trawlers can be divided into two length classes: 12–18 m and 24–40 m[1]. Large trawlers prevailed among the vessels engaged in fishing in 2010. Preference for large trawlers in fishing can be explained by their greater efficiency. Greater efficiency enables e.g. better wages to be paid to crews.

Basic and economic indicators of 12–18 m length class trawlers in 2010

As regards small trawlers, catches were reported for 12 vessels owned by six companies in 2010. These trawlers caught a total of 2200 t of fish, representing just 3.2% of the total trawl catch. Based on first sale prices, the value of the catch was around 300,000 euros. The trawlers caught mainly herring and sprat. Compared to the previous two years, when the share of sprat in the total catch was 25%, in 2010 the share of sprat increased to 44% (Figure 27).

Compared to 2008, the number of small trawlers engaged in fishing decreased by almost 50%, i.e. from 23 to 12 (Table 19). A similar decline was also observed in the number of employees. Whereas in 2008 the average number of fishermen employed on small trawlers was 37[2], by 2010 this number had decreased by 17 (46%) to 20.

1 Except the Ann-Mari I fishing vessel, which is 19.99 metres long, but which belongs to the group of large trawlers due to its engine power (220 kW) and tonnage (99 t)

2 Average number of employees during the year

Nevertheless, fishing capacity was higher in 2010 than in the previous two years, and the number of trawling hours per vessel was higher as well. The average annual labour cost per employee was 3696 euros in 2010 (including an estimated annual gross salary of 2750 euros per year), or 12% more than in 2008. The total added value of the segment of small trawlers amounted to 161,000 euros.

Operating expenses related to the fishing operations of trawlers of the 12–18 m length class were 198,000 euros in 2010. Labour and fuel made up the largest proportion of expenses, accounting for 37% and 31% respectively (Figure 28).

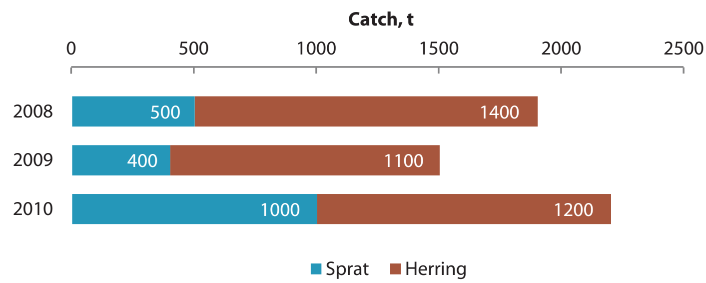


Figure 27. Share of sprat and herring in catch of small trawlers from 2008–2010. Source: MoA

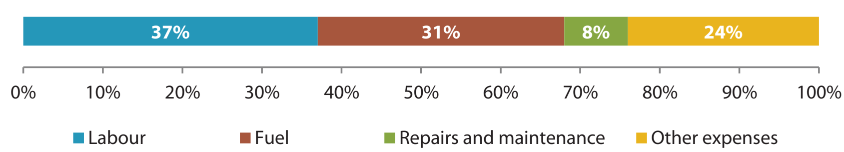


Figure 28. Distribution of operating expenses related to fishing operations of fishing vessels of 12–18 m length class in 2010. Source: UT EMI

Table 19. Basic and economic indicators related to fishing operations of 12–18 m length class trawlers from 2008–2010

	2008	2009	2010
Number of fishing vessels	23	14	12
Catch, 10^3 t	2	1.5	2.2
Value of catch based on first sale prices, 10^3 €	322	207	285
Average number of employees	37	22	20
Average labour cost per employee, €	3312	3435	3696
Average gross salary per employee, €	2485	2566	2750
Average number of trawling hours per vessel	154	163	178
Average fuel price € l^{-1}	0.553	0.550	0.704

Source: MoA, UT EMI

Basic and economic indicators of 24–40 m length class trawlers in 2010

As regards large trawlers, in 2010 catches were reported for 36 vessels owned by 20 companies. These trawlers caught a total of 66,100 t of fish, whose estimated total value amounted to nearly 10 million euros based on average first sale prices. Unlike the catch of the segment of small trawlers, which was dominated by herring in terms of tonnes caught, sprat prevailed in the catch of large trawlers. Sprat and herring made up 71% and 28% respectively in the total catch of 2010. Compared to the previous two years, the share of herring decreased slightly (Figure 29).

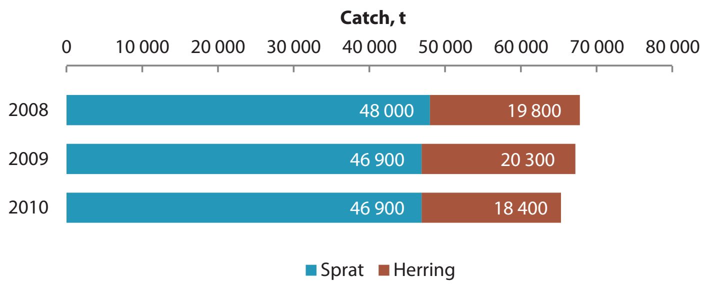


Figure 29. Share of sprat and herring in catch of large trawlers from 2008–2010. Source: MoA

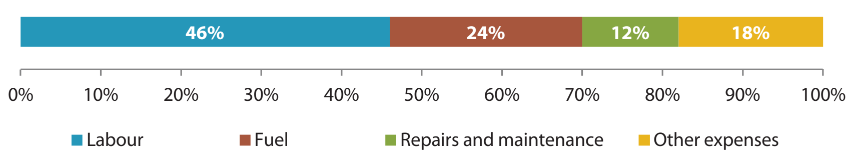


Figure 30. Distribution of operating expenses related to fishing operations of fishing vessels of 24–40 m length class in 2010. Source: UT EMI

Table 20. Basic and economic indicators related to fishing operations of 24–40 m length class trawlers from 2008–2010

	2008	2009	2010
Number of fishing vessels	40	39	36
Catch, 10^3 t	68.9	68	66.1
Value of catch based on first sale prices, 10^6 €	11.9	10.7	9.2
Average number of employees	236	227	207
Average labour cost per employee, €	16 072	16 238	16 748
Average gross salary per employee, €	12 057	12 129	12 510
Average number of trawling hours per vessel	1152	1025	812
Average fuel price € l^{-1}	0.503	0.377	0.486

Source: MoA, UT EMI

Compared to 2008, the number of large trawlers engaged in fishing decreased by 10%, i.e. from 40 to 36 (Table 20). Hence, the number of employees dropped as well. While in 2008 the average number of fishermen employed on large trawlers was 236, by 2010 this figure had decreased by 12% and amounted to 207. Fishing capacity and the number of trawling hours per vessel declined, too. The average annual labour cost per employee was 16,748 euros in 2010 (including an estimated annual gross salary of 12,510 euros), or 4% more than in 2008. The total added value of the segment of large trawlers amounted to 5.2 million euros.

Operating expenses related to the fishing operations of trawlers of the 24–40 m length class were 7.5 million euros in 2010. Labour and fuel made up the largest proportion of expenses, accounting for 46% and 24% respectively (Figure 30).

Inland fisheries

FISH STOCKS IN LAKE VÕRTSJÄRV AND THEIR MANAGEMENT

Lake Võrtsjärv and its inflows are known to be permanently inhabited by 31 species of fish (Järvalt *et al.*, 2004). Ruff, bream and roach are the most abundant species, followed by silver bream and bleak. In terms of biomass, bream clearly prevails in the fish community (Table 21). As for valuable predatory fish, there is plenty of pikeperch and pike in the lake. Compared to many other lakes, however, the abundance of perch is relatively modest in Lake Võrtsjärv.

In comparison with our other inland bodies of water, Lake Võrtsjärv is unique for eel farming. Eels have been farmed here since 2008 in accordance with the requirements of a Commission Regulation and the Estonian Eel Management Plan. Therefore, specific fishery-related conditions must be applied in Lake Võrtsjärv. For decades, only passive gear (trap nets and gill nets) have been used in commercial fishing. According to the Environmental Charges Act, the fishing charge payable for fishing gear used to fish eel (trap nets) is significantly higher than in most inland water bodies, exceeding 300 euros per trap net per year. Up till now, the entire amount of charges collected has been used to purchase restocking material. By contrast to purely 'native' species, eel farming enables a much greater number of fishermen to earn a living.

Commercial fishing on Lake Võrtsjärv is particularly important in terms of securing employment in the region and helps maintain the local fisherman's age-old profession as an integral part of the management of the lake. In 2010 a total of 44 commercial fishing permits were issued for Lake Võrtsjärv, either to sole proprietors, private limited companies or fishers operating in other forms of business (Figure 31). In addition, over 20 assistant fishermen have been listed on fishing permits each year. All in all some 65–70 people are involved in fishing to a greater or lesser extent on Lake Võrtsjärv.

The amount of fishing gear and the fishing effort have not changed in recent years. In 2010 permits were issued for fishing with 324 trap nets and 360 gill nets, including 40 recreational gill net permits. Thus, there is 170 m of trap net per 83 hectares and 70 m of gill net per 75 hectares of Lake Võrtsjärv. Owing to the state of fish stocks, the need to distribute fishermen's income over the year (Figure 32) and the increasing need for free waters in summer time, fishing with gill nets is closed on Lake Võrtsjärv from the break-up of ice until the end of August.

Long-term statistics on fishing on Lake Võrtsjärv are given in Table 22. Over the last decade, the total catch has remained within the limits of 300–400 tonnes, in which valuable fish accounts for 60–70%.

Table 21. CPUE by weight, abundance and proportion of fish species in Lake Võrtsjärv in 2010 based on test trawls (CPUE – grams or individuals per trawling hour) (Järvalt *et al.*, 2010b)

Liik		Weight, g h^{-1}	%	Abundance, ind h^{-1}	%
Bream	*Abramis brama*	98 929	46.0	4768	28.1
Roach	*Rutilus rutilus*	27 190	12.6	4087	24.1
Silver bream	*Blicca bjoerkna*	26 567	12.3	1157	6.8
Pikeperch	*Sander lucioperca*	24 942	11.6	108	0.6
Ruff	*Acerina cernua*	22 801	10.6	6271	36.9
Pike	*Esox lucius*	7997	3.7	11	0.1
Perch	*Perca fluviatilis*	2824	1.3	196	1.2
Burbot	*Lota lota*	2096	1.0	4,0	0.0
Bleak	*Alburnus alburnus*	1679	0.8	353	2.1
Lake Peipsi smelt	*Osmerus eperlanus*	108	0.1	21	0.1
Eel	*Anguilla anguilla*	102	0.0	0,4	0.0
Total		**215 235**	**100.0**	**16 976**	**100.0**

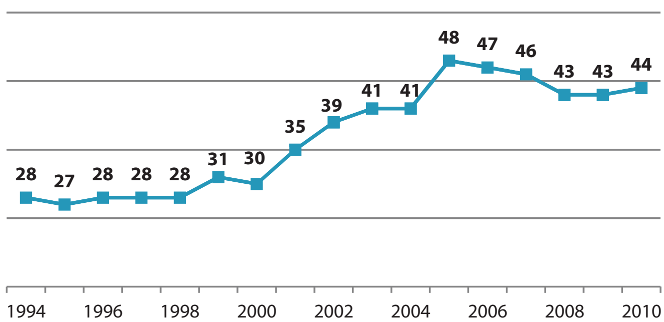


Figure 31. Number of commercial fishing permits issued for Lake Võrtsjärv, 1994–2010

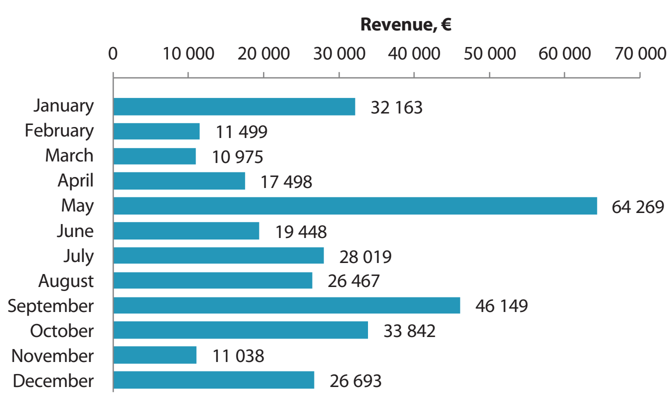


Figure 32. Value of catches from Lake Võrtsjärv based on first sale prices and distribution of revenue by month in 2010

The rest of the catch is composed of by-catches of 'second-rate' fish accompanying trap fishing, in which bream, for which no catch limits have been established in Lake Võrtsjärv, accounts for around 85%. The share of second-rate fish in the total catch has declined in recent years, as there is no market for it and some of the fish is discarded (Järvalt *et al.,* 2010b). Trap catches account for nearly 80% and gill net catches account for 20% in commercial fishing catches. In the latter catches, pikeperch accounts for 85%.

Due to a decline of eel catches in recent years, pikeperch made up the largest share of revenue of fishermen (33% in 2010), followed by eel (24%), bream (17%), pike (16%) and perch (8%). Based on first sale prices, the share of all other species accounts for just 2% of revenue. The value of reported catches from Lake Võrtsjärv, based on first sale prices, amounted to *ca.* 325,000 euros in 2010.

Eel. Revenue from eel fishing has been the backbone of Lake Võrtsjärv fishery for almost half a century. Eel catches are directly dependent on the volume of restocking (which is related to the price level of restocking material) 5–10 years previously. Eel catches have been fairly small over the last decade, being several times lower than the long-term average (32 t) (Table 22, Figure 33). Restocking of the cohorts being fished now has been relatively modest in terms of numbers. On the other hand, rising water levels have also reduced eel catches, placing fishermen in a difficult position. Similar to the years of high water that began in the early 1980s, eel catches decreased several times in the past couple of years (Table 22, Figure 33). The first conclusion that can be drawn is that the higher the water level or the rainier and cooler the summer (1998), the lower the eel catch vis-à-vis the forecast.

As the proportion of 'home yard' sales and small-scale processing is increasing, the share of small catches that remain unreported is higher than usual. Then again, it is positive that fishermen are increasingly adding value to their catches

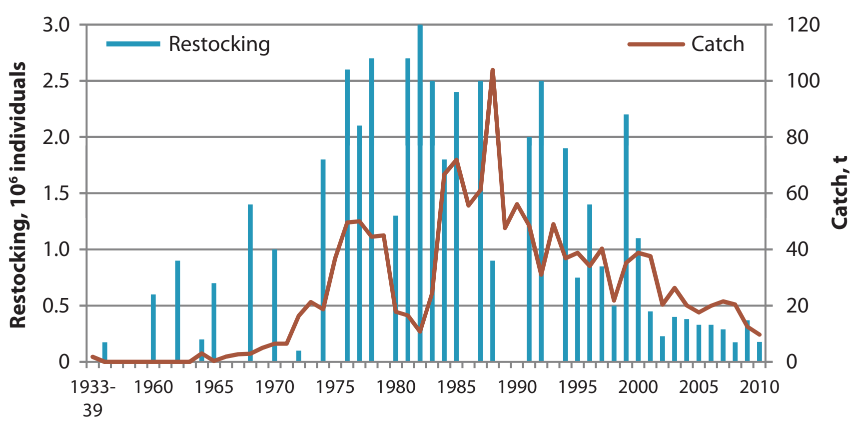


Figure 33. Eel restocking and catches in Lake Võrtsjärv, 1933–2010

Table 22. **Catches (t) from Lake Võrtsjärv from 1971–2010.**
'Other' includes tench, Crucian carp, Gibel carp and ide. The figures for 2000–2010 also include catches from restricted and recreational fishing in addition to commercial fishing.

Year	Eel	Piker-perch	Pike	Bream	Burbot	Perch	Other	Second-rate fish	Total
1971	6.5	28.1	12.9	20.1	2.7	4.5	0.5	75.3	**150.6**
1972	16.4	32.3	14.0	21.4	2.4	3.3	0.8	80.7	**161.4**
1973	21.3	43.0	11.5	16.0	1.2	3.8	0.4	92.3	**184.6**
1974	18.7	50.7	17.6	25.9	2.7	0.9	0.2	42.6	**161.9**
1975	36.9	51.8	12.3	23.8	1.3	1.6	0.3	41.3	**151.1**
1976	41.6	46.3	9.0	27.1	1.6	1.0	0.1	33.1	**155.1**
1977	50.0	45.3	12.8	33.2	1.7	0.6	0.3	20.8	**156.3**
1978	45.0	62.0	17.8	31.7	2.6	2.7	0.3	42.1	**209.2**
1979	19.0	73.0	19.0	26.1	3.0	3.0	0.8	40.3	**210.2**
1980	17.8	50.9	24.8	42.0	11.2	9.1	0.6	53.1	**210.7**
1981	16.4	42.4	29.3	63.0	17.9	7.9	0.4	68.4	**247.1**
1982	10.8	55.2	34.5	45.8	8.8	9.2	0.3	72.0	**242.2**
1983	24.6	50.5	51.4	60.0	7.4	8.8	0.6	85.3	**274.8**
1984	66.7	36.9	50.4	59.9	8.9	7.2	0.3	104.0	**292.2**
1985	71.9	59.0	39.0	100.1	7.4	5.4	0.3	168.4	**446.3**
1986	55.6	68.2	61.4	74.7	6.9	9.4	0.6	205.4	**498.5**
1987	61.2	45.5	35.0	76.9	6.6	7.0	1.2	163.3	**391.1**
1988	103.7	53.4	48.7	127.0	6.6	6.3	1.2	330.4	**634.8**
1989	47.6	44.5	56.4	196.7	5.9	7.4	1.4	303.6	**719.6**
1990	56.1	18.8	45.8	194.4	2.5	4.4	1.0	147.8	**414.7**
1991	48.5	26.7	30.5	139.4	4.8	3.7	1.4	212.5	**419.0**
1992	31.0	14.0	25.0	100.0	3.3	6.2	0.3	97.7	**246.5**
1993	49.0	36.0	32.0	81.0	7.0	8.0	0.8	107.0	**271.8**
1994	36.9	25.5	23.4	87.8	4.2	5.4	1.4	79.1	**226.8**
1995	38.8	28.3	19.4	68.7	1.4	5.2	0.1	112.8	**235.9**
1996	34.1	22.3	28.1	69.1	3.0	2.1	0	88.2	**212.8**
1997	40.3	20.7	19.3	92.3	3.4	2.4	0.1	98.0	**236.2**
1998	21.8	43.7	16.1	70.5	3.8	2.9	0.1	81.9	**219.0**
1999	37.4	34.5	24.9	47.8	2.6	12.1		116.7	**275.9**
2000	38.8	29.5	40.7	54.4	3.8	18.3	2.0	150.1	**337.6**
2001	37.6	32.8	50.8	56.8	4.0	12.6	0.2	191.7	**376.5**
2002	20.4	25.2	44.8	30.5	3.5	9.7	0.1	184.3	**318.8**
2003	26.4	19.2	49.8	42.3	6.0	14.2	0.1	157.9	**315.9**
2004	20.1	27.3	55.5	59.1	4.1	10.1	0.1	176.9	**353.2**
2005	17.6	46.7	52.6	57.3	2.5	15.4		192.5	**379.1**
2006	19.9	42.3	79.5	65.5	2.8	44.1	0.1	127.9	**381.7**
2007	21.5	29.7	57.0	105.2	3.6	17.1	0.1	174.6	**407.3**
2008	20.5	48.3	31.6	158.2	7.8	10.8	1.7	229.0	**507.9**
2009	13.6	74.1	33.0	81.5	2.9	9.0	1.6	131.9	**347.6**
2010	10.3	29.1	34.3	56.9	2.3	13.7	0.8	119.2	**266.6**

(especially as regards eel) locally, selling smoked or pickled eels in tins or glass jars. Thus the price of raw fish almost doubles in home yard sales. Also, the first sale price of eel has increased considerably in the last few years, which partially offsets the decline in revenue due to decreasing catches.

In the case of restocking with glass eels, potential catches from Lake Võrtsjärv can be estimated. The eel catch in the eighth year after the introduction of glass eels strongly correlates to the number of glass eels introduced into the lake.

The restocking volume determines e.g. 50% of catch variability eight years later (Figure 34). After a million eels have been introduced into the lake, catches amounting to a total of about 25 tonnes are reported during the period that the cohort is fished (6–14 years). During this period, around 50,000 to 60,000 eels are caught, as the average weight of an eel caught in trap nets is 450–500 g. According to official catch statistics, the recapture of elvers introduced to the lake amounts to app. 5% (Järvalt *et al.*, 2010b).

According to marking data, up to 15% of commercial stocks (i.e. eels longer than 50 cm) are caught from Lake Võrtsjärv every year. Given that natural mortality is negligible among eels of this size, most of the eels emigrate from the lake. Thus most of them arrive in the Gulf of Finland through Lake Peipsi and the Narva River, as a study of marked eels showed that the dam and turbines of the Ivangorod hydroelectric station are not an impassable barrier (Järvalt *et. al.*, 2010a).

Overall, eel catches are low in Lake Võrtsjärv, amounting to less than 1 kg ha^{-1} in recent years. The food base in Lake Võrtsjärv is sufficient for a bigger population of eels and would enable restocking volumes to be multiplied. Additional funds for this would have to be found both at the national level and from the European Fisheries Fund. As the requirement of the Commission Regulation to ensure the egress of 40% of migrating eels from the basin of Lake Peipsi is being met, restocking should be given every support, even if only from a species conservation point of view.

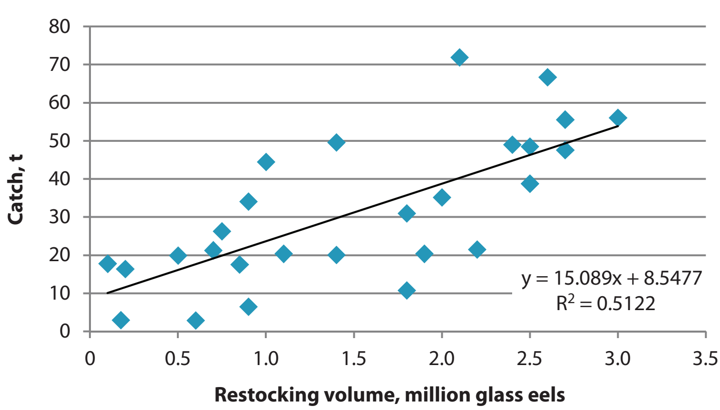


Figure 34. **Dependence of eel catches on number of glass eels introduced to Lake Võrtsjärv eight years previously**

Pikeperch. Due to the low levels of eel catches, pikeperch stocks are gai more importance for fishermen on Lake Võrtsjärv. Being shallow, warm and with low transparency, Lake Võrtsjärv is an ideal place for pikeperch to catch prey in the turbid water. Lack of stratification and high primary production are some of the most important features of a perfect lake for pikeperch, securing sufficient food resources. Heaped stones mixed with gravel and sand are suitable spaw grounds for pikeperch – and there are a lot of these in Lake Võrtsjärv (Järvalt *et al.*, 2004).

Pikeperch is highly sensitive to changes in environmental conditions as well as to overfishing. In the 1930s an average of 35 t of pikeperch was caught from Lake Võrtsjärv annually. Excessive trawling in the 1950s and 1960s almost destroyed the pikeperch stocks. Since the begin of the 1970s, after a ban on trawls with small mesh sizes, the abundance of pikeperch remained at a relatively stable level (for a wild population) in the lake until the begin of the 1990s (due to favourable natural conditions and strict regulation of fishing), with the average annual catch amounting to 50 t. Spaw failures in several consecutive years at the begin of the 1990s, as well as high mortality of fish in the late winter of 1987 when nearly 50 t of pikeperch perished, caused the abundance of pikeperch to decline. To some extent, the decline was also caused by more intense fishing, which was due to a sharp increase in prices of fish and a change in fishery management conditions, and probably greater catches than those shown in the incomplete statistics of the time. Compared to the 1980s, pikeperch stocks have been in a good state over the last ten years. The 74 t of pikeperch caught from Lake Võrtsjärv in 2009 was the largest catch ever (Table 22), with nearly 80% of this quantity being caught with gill nets. Under-ice fishing is particularly effective, especially with 'young' ice, when daily catches can reach more than 10 kg per gill net. Deterioration of oxygen conditions in the lake, especially in cold and snow-rich winters, cause pikeperch catches to decline in under-ice fishing (Järvalt *et al.*, 2005).

The strength of a year class of pikeperch is determined by the abundance of Lake Peipsi smelt, which is the primary food item during the transition of the pikeperch to prey food in the first summer of its life. In the absence of smelt, small fry of pikeperch are forced to feed on zooplankton over the summer; they grow slowly and their winter mortality increases significantly (Ginter *et al.*, 2011).

Unlike in other lakes, the minimum size of pikeperch in Lake Võrtsjärv has been 51 cm (TL) for around ten years, which enables pikeperch to reproduce for at least a couple of years before being caught. Natural mortality of this predatory fish at the top of the food chain is low, and pikeperch puts on 300–500 g a year. This ultimately means higher catches of each year class, as the fish have more time to grow.

Pike. Despite the huge fluctuations in abundance, pike has never lost its importance as a commercial fish in Lake Võrtsjärv. Pike abundance is directly related to the level of water in the lake (Järvalt & Pihu, 2002). After spaw on floodplains, the abundance of offspring depends on the extent and duration of flooding. The latter determines whether pike larvae have enough time to hatch and return to the lake. The strength of a year class also depends on the abundance of aquatic vegetation. In recent decades, aquatic vegetation as a suitable substrate for pike spaw has been extremely widespread in Lake Võrtsjärv, which has expanded spaw grounds even in the case of lower water levels in spring. When water levels were very low, as in spring 1996, the entire southern lake resembled a flooded meadow. An exceptionally strong pike cohort appeared that year.

Pike and pikeperch have an important natural role in regulating the abundance of 'second-rate' fish. Unfortunately, the abundance of pike in Lake Võrtsjärv has declined again in recent years. In 2006, a record catch (80 t) of pike was caught from Lake Võrtsjärv. Since then, catches have decreased drastically, but not below the long-term average (30 t). The main reason for this is probably not related to a proportional decrease in pike stock in the lake, but rather to the time limits on pike fishing.

For example, in 2008 the ice cover melted in mid-February and therefore pike spawned in early April. Pike is fished mainly with trap nets in two periods: early May, immediately after spaw; and in October, before the removal of trap nets. However, as the closed period in spring when pike may not be fished ends on 30 April, a large part of the usual quantity of pike cannot be caught in years when ice melts early, as in spring 2007 and 2008. At the same time, fishermen need to make efforts to throw back tonnes of pike caught in trap nets during the closed period. The importance of gill nets in pike catches is below 15%.

Bream. Bream is the most abundant fish species in Lake Võrtsjärv. Until a few decades ago, it was small and grew slowly here, because while the spaw conditions were ideal the food base was fairly small. The growth rate of bream is faster in Lake Peipsi and in most of the larger lakes in Europe than in Lake Võrtsjärv. By derogation from other bodies of water, catch limits for bream in the lake were lifted in 1978: bream may be caught regardless of size and time. Bream directly competes with eel for food in the lake, as they both prefer chironomid larvae.

Following the abolition of limits in 1978, bream catches increased from 20–30 t to 200 t or 7.5 kg ha^{-1} in 1989. The bream catch also increased sharply in 2008 when more than 150 t of large breams (longer than 30 cm measured to the end of scale cover) were caught once again. According to verified data, bream stocks are temporarily replenished with individuals from the Emajõgi River and Lake Peipsi (Tambets *et al.,* 2002), which is probably the main reason for the temporary increases in bream catches.

Recreational fishing on Lake Võrtsjärv

Pikeperch, followed by bream and pike, produces the largest catches in recreational fishing with gill nets and longlines on Lake Võrtsjärv. In 2010 the maximum number of longlines consisting of 100 hooks was 90 per month. A total of more than half a tonne of eels was caught with the longlines, which accounted for 5% of the total eel catch (Figure 35). Catches using other recreational fishing gear are not known, but given the relatively small interest of recreational fishermen in the lake, their share is marginal compared to commercial fishing.

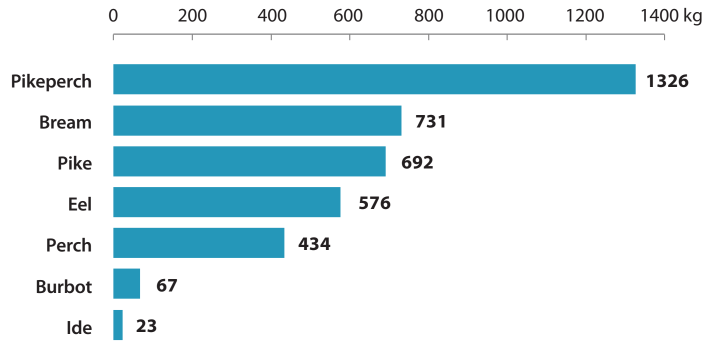


Figure 35. **Gill net and longline catches (kg) in recreational fishing on Lake Võrtsjärv by species in 2010**

Outlook

The fish stocks of Lake Võrtsjärv have been in a relatively good state in recent years, which suggests that ongoing, decades-long studies and the strictly regulated types and numbers of fishing gear in line with the results of studies have contributed to the sustainable management of fish stocks. Also, the fact that pikeperch and pike cohorts remain in catches for more than 10 years bear witness to reasonable exploitation. The prospects of catches for the next few years are good or very good for most important species (Table 23).

Supporting the fisheries areas through the European Fisheries Fund will also create better opportunities for the development of fishery and fishing tourism in the coming years. In 2008 the NGO Võrtsjärve Kalanduspiirkond was formed in the Lake Võrtsjärv region, which unites many commercial fishermen in the area.

Table 23. **General assessment of state of stocks and fishing mortality in Lake Võrtsjärv in 2011 and near future broken down by important species.** (State of stocks: 1 – high, 2 – moderate, 3 – low, 4 – depleted; fishing mortality level: A – low, B – moderate, C – high, D – insufficient data are available.)

Species	State of stocks			Fishing martality level
	2011	Up to 2012	Up to 2015	
Eel	3	3	2	A
Pikeperch	2	1	1	B
Pike	2	2	3	B
Bream	3	3	2	C
Perch	3	3	3	B
Burbot	3	3	2	A
Lake Peipsi smelt	4	4	4	D

LAKE PEIPSI FISHERIES

Lake Peipsi and Lake Pskov and rivers discharging into them are home to 40 fish species of different levels of demand (Saat & Vaino, 2010). As for its natural conditions, Lake Peipsi today is primarily suitable for pikeperch and bream. The lake is still characterised by high fish productivity; Lake Peipsi and Lake Lämmijärv provide app. 90% of Estonia's inland fish catches. The fish stocks of the two lakes are jointly used by the Republic of Estonia and the Russian Federation; the fish stocks of Lake Pskov are managed by the Russian Federation.

Management of fish stocks

Fishery-related cooperation started between the Republic of Estonia and the Russian Federation in 1994 with a view to sustainable management and protection of fish stocks in Lakes Peipsi, Lämmijärv and Pskov and is advancing satisfactorily. The lake management system has become more diverse over time, and also more complex. In addition to traditional fishing regulations applied to lakes (maximum numbers of traps and trap parameters, minimum fish sizes and closed seasons and areas), internationally agreed quotas have also been introduced here (between Estonia and Russia). Quotas are set for all major commercial fish species and are of primary importance in fishing. Overall, it should be acknowledged that the establishment of quotas has contributed to the sustainable exploitation of the stocks of valuable fish in the lake.

While Estonia does not divide national fishing quotas into individual quotas (IQ), Russia does. The introduction of IQs would be justified in the environment of effective supervision, which includes designated landing sites. Thus the official catches of Russia have decreased considerably since the introduction of IQs (2008) compared to the Estonian side (Figure 36).

Estonia's national fishing quotas (reflecting the state of fish stocks) as recommended by the Estonian-Russian Intergovernmental Fisheries Commission are set out in Table 24. Fishing quotas for Lakes Peipsi and Lämmijärv are initially equal, but are usually amended when overfishing is taken into account and quotas are exchanged.

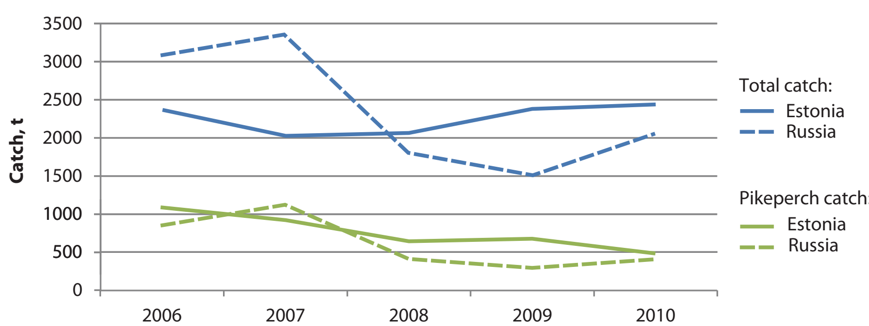


Figure 36. Estonian and Russian total catches and pikeperch catches (t) from Lakes Peipsi and Lämmijärv from 2006–2010. Source: UT EMI

Table 24. Estonian national fishing quotas (t) on Lakes Peipsi and Lämmijärv from 2006–2010 (quota exchanges and deductions on account of overfishing taken into account)

Species	Year				
	2006	2007	2008	2009	2010
Pikeperch	1000	1029	1000	600	546
Perch	396	1000	820	850	1200
Pike	85	110	95	85	70
Bream	700	625	700	570	460
Roach	600	500	475	330	330
Burbot	50	50	50	50	50
Ruff	750	500	300	300	300
Smelt	1000	100	5	5	5
Whitefish	10	10	7	5	7
Vendace	0	1	1	1	1
Other species	50	50	50	50	50
Total	**4641**	**3975**	**3503**	**2846**	**3019**

Source: UT EMI

State of fish stocks

In around the middle of the last decade, significant changes occurred in the stocks of the key fish species of the lake (which are also the major target species). In 2005 very strong year classes of pikeperch and perch appeared which, with the help of environmental conditions, had destroyed the smelt population of the lake by the end of 2006. Smelt was deleted from the list of Lake Peipsi target species and no recovery of the stocks has since been observed. Food shortages caused a deceleration in the growth rate of pikeperch and perch. Moreover, no considerable cohorts of pikeperch and perch appeared until 2009. By the mid-2000s the commercial stocks of pikeperch and perch had dropped (Estonian Fisheries 2005) to such an extent that further catches could only rely on juveniles. The situation called for stringent fishing measures (closed seasons) and unusual concessions (reduction of the minimum allowable size of pikeperch). Perch is now becoming the main predatory fish in the lake.

Pikeperch. The situation with this species, which has been the most important target fish in Lake Peipsi over the last few decades, is complicated and requires a sustainable approach. The current commercial stocks, which are mainly based on the very strong pikeperch cohort of 2005, are at a relatively high level, but subsequent year classes (except the year class of 2009) have been weak (Figure 37, Table 25). Therefore, it is clear that commercial stocks of pikeperch will contract significantly in the lake when the 2005 year class is exhausted. Due to the lack of smelt, juveniles grow slowly, but older fish (three- and four-summer-old) can grow quite well during a long growth period when high temperatures prevail (as in 2010) (Table 26). Thanks to catch limits, the year class of 2005 was managed in a more sustainable manner than earlier year classes (e.g. the strong year class of 2001), but the total mortality (Z) of the year class remained very high from 2005–2010 or 0.83 on average (i.e. ~56% of fish were either caught or died due to natural conditions each year). According to recommendations, total mortality should not have exceeded 0.5 (i.e. no more than ~40% of fish should have died each year). The high total mortality was not caused so much by fishery on juveniles, as this was limited for five years (seasons when the use of Danish seines was prohibited), but rather by natural and hidden fishing mortality (poaching and mortality through trap net fishing). In view of the 3–4 times lower abundance and biomass of the 2009 year class of pikeperch compared to the cohort of 2005, it is clear that this year class must be exploited under an even more moderate scenario. Otherwise, both stocks and catches will rapidly decline in the coming years. Figure 38 shows different scenarios for the dynamics of the

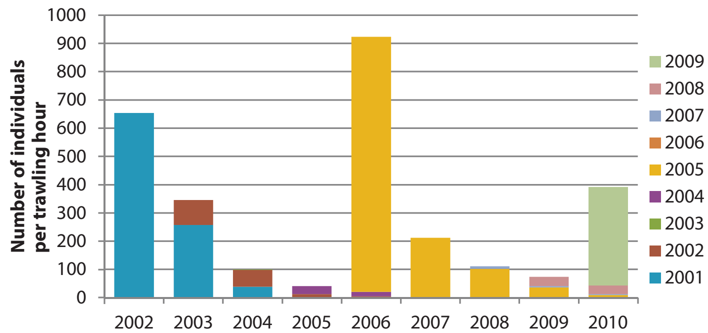


Figure 37. Pikeperch abundance (number of individuals per trawling hour) in Lake Peipsi from 2002–2010 broken down by year class. Different colours denote different year classes. Source: UT EMI

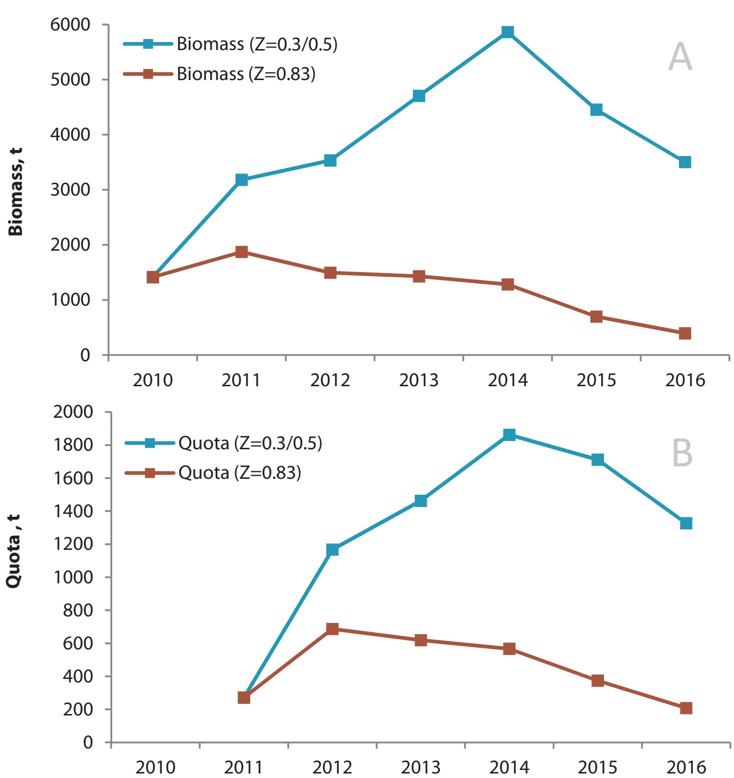


Figure 38. Biomass (A) and future fishing quotas (B) of 2009 year class of pikeperch with different rates of total mortality (Z). Source: UT EMI

Table 25. **Pikeperch abundance (number of individuals per trawling hour) and weight (TW; kg per trawling hour) based on trawl fishery in Lake Peipsi from 2001–2010 (the numbers in bold indicate strong year classes in the 2000s)**

Abundance			Age group				
Catch year	0+	1+	2+	3+	4+	>4+	Total
2001	**852**	40	102	3	11	2	**1010**
2002	125	**654**	16	16	0	0	**812**
2003	0	88	**258**	5	0	0	**351**
2004	130	1	60	**39**	1	0	**230**
2005	**1424**	28	0	11	**2**	0	**1466**
2006	0	**902**	16	0	4	**1**	**923**
2007	148	0	**209**	2	0	1	**359**
2008	552	9	0	**102**	1	0	**664**
2009	**107**	33	4	0	**35**	2	**182**
2010	0	**347**	32	3	0	**10**	**392**
TW			**Age group**				
Catch year	**0+**	**1+**	**2+**	**3+**	**4+**	**>4+**	**Total**
2001	**27**	7	53	4	20	7	**117**
2002	4	**186**	11	19	1	1	**222**
2003	0	11	**146**	5	1	0	**162**
2004	2	0	19	**33**	1	0	**56**
2005	**33**	6	0	9	**4**	0	**52**
2006	0	**119**	12	0	6	**2**	**139**
2007	1	0	**55**	3	0	1	**59**
2008	2	1	0	**49**	3	0	**54**
2009	**1**	3	1	0	**37**	5	**47**
2010	0	**30**	20	4	0	**22**	**75**

Source: UT EMI

Table 26. **Growth of pikeperch year classes (total length TL and weight TW) in Lake Peipsi from 2001–2010**

TL (cm)					Year class					
Age	2001.	2002.	2003.	2004.	2005.	2006.	2007.	2008.	2009.	2010.
0+	16	16	10	13	14	11	9	8	9	–
1+	31	25	22	29	26	–	22	23	22	
2+	40	35	37	42	32	–	33	40		
3+	45	44	–	52	38	–	48			
4+	55	55	–	64	47	–				
5+	65	63	–	69	58					
TW (g)					**Year class**					
Age	**2001.**	**2002.**	**2003.**	**2004.**	**2005.**	**2006.**	**2007.**	**2008.**	**2009.**	**2010.**
0+	33	33	7	19	23	8	5	3	6	–
1+	283	122	94	206	132	–	83	97	86	
2+	565	352	400	741	261	–	339	616		
3+	856	811	–	1510	478	–	1144			
4+	1746	1677	–	2713	1049	–				
5+	2948	2696	–	3632	2156					

Source: UT EMI

Table 27. Perch abundance and weight (number of individuals by age group and total weight per trawling hour) in Lake Peipsi from 2006–2010

Catch year	Abundance						Weight (kg)
	1+	2+	3+	4+	>4+	Total	
2006	4738	61	0	1	4	**4806**	94
2007	11	1965	53	0	5	**2034**	82
2008	2	0	1267	12	3	**1284**	81
2009	7	7	0	812	14	**840**	79
2010	4422	46	4	4	546	**5022**	178

Source: UT EMI

stocks (biomass) and possible quotas of the 2009 cohort of pikeperch. The first scenario assumes moderate total mortality – 0.3 in 2011 and thereafter 0.5 – while the second is based on the recurrence of the fate of the cohort of 2005, whose total mortality was 0.83. Unfortunately, hidden fishing mortality cannot be done away with immediately and, under pressure from fishermen, the Estonian-Russian Intergovernmental Fisheries Commission decided at its last session that the 2009 year class of pikeperch should be exploited on the basis of the second rather than the first scenario (too long a period of fishing with Danish seines on the part of Russian fishermen).

Perch. The perch stocks of Lake Peipsi are also under strong fishing pressure. Recent years have seen catches mainly based on the very strong year class of 2005. Due to catch limits and the addition of the strong year class of 2009, perch stocks are still in relatively good shape. Perch abundance is at the level of 2006, but the biomass is two times higher than in previous years (Table 27). Due to the absence of smelt, the growth rate of fish born in 2005 was very slow (with the standard length and weight of a 6-year-old fish being 22 cm and 125 g); the cohort of 2009 is growing at the same pace. The 2005 year class of perch has been caught in a sustainable manner; from 2007–2010 the total mortality (Z) was 0.44 i.e. 35% of the fish died each year due to commercial and recreational fishing and natural causes. Estonia's catch quota is likely to be around 1000 tonnes in the coming years.

Other species. In addition to smelt, the stocks of other cold-water fish (vendace, whitefish and burbot) are low as well. The main reason for the low level of stocks of these species are not predatory fish or fishing, but unsuitable living conditions (in particular the deteriorating breeding conditions) in today's lake. With the support of 'normal' winters (with longer-lasting ice) the state of vendace stocks has improved a little. Apparently, the slight improvement in the state of the vendace population can also be associated with the biological characteristics of this species (vendace fry grow rapidly, and pikeperch fry of the same year cannot feed on them). Stocks of commercial fish of local importance (bream and roach) are likely to decline in the coming years, as growth in both of these species has been weak in recent years. As for the bream population, a decrease in the abundance of older fish can clearly be observed. The growth in pike, on the other hand, has been relatively high in recent years, and commercial stocks should increase.

Given the general state of the lake and weather conditions, no significant positive changes in the fish stocks of the lake are expected to occur in the near future.

Fishing capacity

The maximum permitted amounts of commercial fishing gear for the Estonian side of Lake Peipsi and Lake Lämmijärv have remained unchanged for years, except for the deletion of 300 smelt trap nets from the list of fishing gear due to the collapse of smelt stocks. Currently, the fishing gear that may be used includes 20 demersal seines, 3000 gill nets (more than 1 km from the shore in Lake Peipsi and more than 500 m from the shore in Lakes Lämmijärv and Pskov), 681 gill nets within up to 1 km in the coastal zone of Lake Peipsi and within up to 500 m in the coastal zone of Lakes Lämmijärv and Pskov, 490 trap nets in a line of trap nets, 411 pelagic and fyke nets, 5 fyke nets without a leader, 15 anchored gill nets, 5 shore seines, 3 purse seines and 10 longlines (with 100 hooks in each). Of these, only the maximum amounts of demersal seines and nets used in the open part of the lake are regulated by the Estonian-Russian fisheries treaty, while the maximum amounts of other fishing gear are established nationally. In the coastal zone of the lake, recreational fishermen may also fish with commercial fishing gear. To this end, 872 gill net permits have been issued.

The permitted fishing gear (4640 pieces in total) is used by around 70 companies with historical fishing rights (operating since 2001). Only eight companies have permits for all of the major forms of fishing gear (demersal seines, nets and traps – total 2508 permits), and two companies have at least 100 permits (722). The rest of the permits (1410) are divided between *ca.* 60 companies. Thus, fishing rights are highly fragmented. This is at least partly due to the auctions conducted from 2001–2003, but even now fishing rights can be transferred and the arrival of new fishers on the lake cannot be ruled out. Fortunately, since 2008 the right to fish with traps has not been issued to those with fewer than 10 permits.

Around 400 fishermen are engaged in fishing today. Compared to the first half of the 2000s, their number has dropped by a third, but the number of fishermen operating on Lake Peipsi should further decrease by half. Also, the number of companies that have fishing opportunities has decreased compared to the first half of the 2000s, when there were approximately 90 such companies (Table 28) (Lake Peipsi Fisheries Development Plan 2005–2009).

Table 28. Number of companies and fishermen connected with Lake Peipsi from 2006–2011

Year	2006	2007	2008	2009	2010	2011
Companies	96	94	87	68	69	70
Total number of fishermen	**530**	**490**	**300**	**336**	**365**	**405**

Source: MoA

Catches

Officially reported commercial catches of Estonian fishermen from Lakes Peipsi and Lämmijärv are usually greater than 2000 t per year (Figure 39a). There are currently seven commercial fish species: pikeperch, perch, pike, bream, roach, burbot and ruff. Smelt was fished for the last time in 2006. Catches of other species include Lake Peipsi whitefish, ide and tench. While pikeperch and pike catches have declined in recent years, catches of perch and bream have increased and those of other target species have remained stable. The proportion of predatory fish that are also export items (pikeperch, perch and pike) in catches usually amounts to 70% (Figure 39b).

Most of the catches from Lakes Peipsi and Lämmijärv are taken with gill nets, different trap nets and demersal seines. Pikeperch represents the major catch of large-mesh gill nets (with a mesh size of 110/130 or more), followed by bream and pike; from 2006–2010 the average catch was 524 t (Figure 40a). Roach and perch dominate the catches of small-mesh nets; annual catches range between 46 and 113 t. Pelagic and fyke nets are small-mesh trap nets and primarily used to catch perch, but to a considerable extent also pikeperch, roach and ruff. Their fishing capacity is demonstrated by the catch of 2010 (~800 t of perch); the average catch of pelagic and fyke nets in the period 2006–2010 amounted to 564 t (Figure 40b).

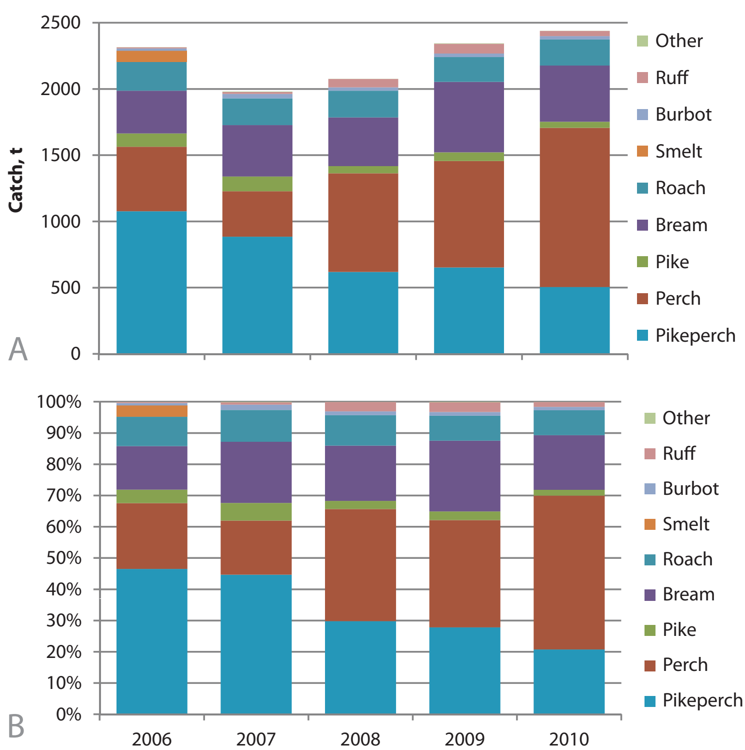


Figure 39. Catches (t) from Lakes Peipsi and Lämmijärv and proportion of individual species in catches (B) from 2006–2010. Source: UT EMI

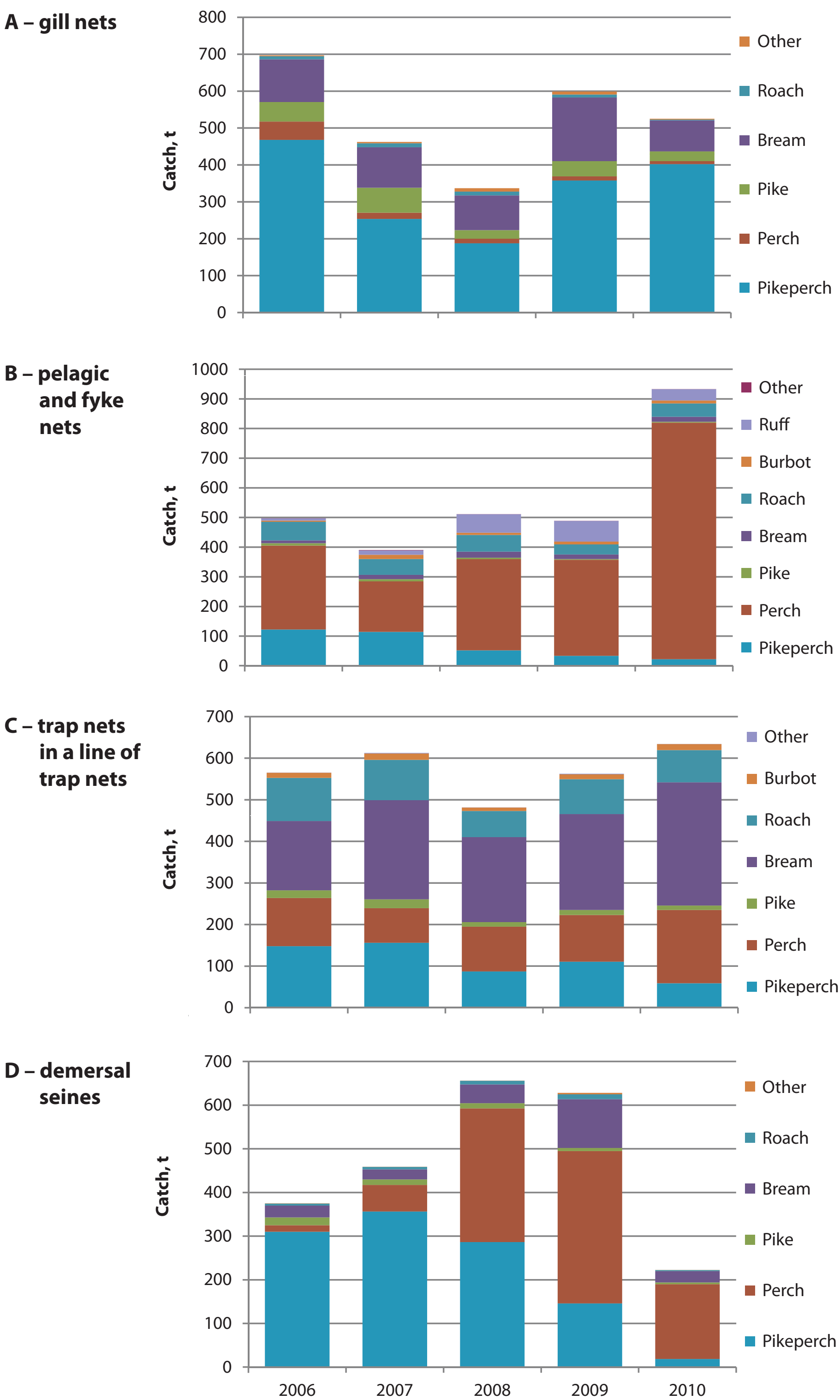


Figure 40. **Lakes Peipsi and Lämmijärv catch composition from 2006–2010 broken down by type of fishing gear.** Source: UT EMI

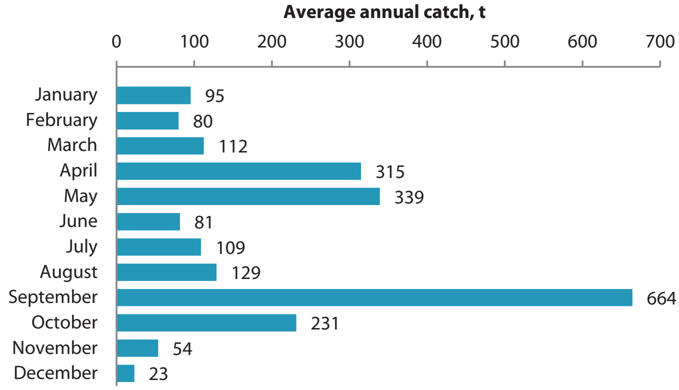


Figure 41. Seasonal dynamics of catches (t) from Lakes Peipsi and Lämmijärv from 2006–2010. Source: UT EMI

The mesh size of trap nets in a line of trap nets is generally larger than that of pelagic or fyke nets. Therefore, the catches of trap nets are more varied, dominated by bream, but contai also pikeperch, perch, pike, roach and burbot (Figure 40c). The average annual catch (571 t) was slightly higher than that of pelagic and fyke nets. As for active fishing gear, demersal seines or Danish seines are used on Lake Peipsi. These seines are designed to catch perch, but they are currently also being used to catch small pikeperch (fish whose size is 40–46 cm smaller than the standard minimum size). The use of these seines has been substantially restricted since 2006 (due to catch limits and exhaustion of quotas) and their average catch amounted to 468 t (Figure 40d). On Lake Lämmijärv, old-fashioned active fishing gear (anchored gill nets) is still used, but their annual catches are less than 10 t.

Fishing on the lake is strongly seasonal in nature, with spring and autumn being the main fishing seasons (Figure 41). Due to excess fishing capacity, the existence of national quotas (which is not conducive to the concealment of catches) and the introduction of a system for advance notification of catches, the autumn fishing period has shortened considerably on the Estonian side in recent years, because quotas are exhausted quicker. In 2010, fishing was closed as early as 1 October; a year earlier nets alone were used from October. The early termination of autumn fishing has had an impact on the companies that hold the right to fish with Danish seines, limiting the fishing period to just two weeks in some years.

Catch value

The value of catches from Lakes Peipsi and Lämmijärv, calculated on the basis of the average first sale prices applicable in Estonia, is presented in Figure 42a. Apparently, the value of a catch so calculated is somewhat overestimated, because only app. one third of fish caught from Lake Peipsi is subject to first sale; most of the fish is simply transferred. In addition, pikeperch and perch caught from

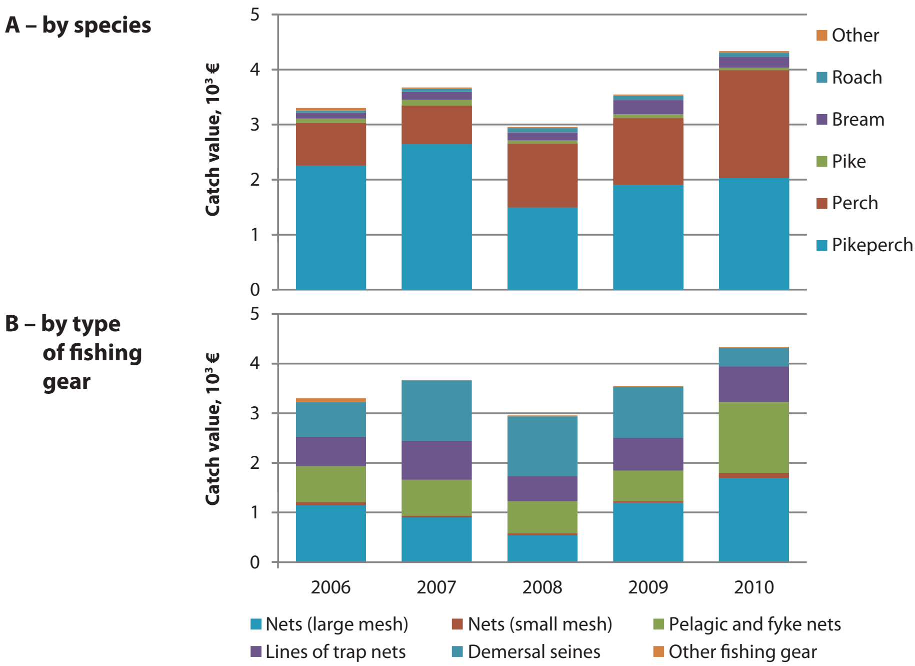


Figure 42. Value of catches from Lakes Peipsi and Lämmijärv from 2006–2010 based on average first sale prices. Source: MoA, UT EMI

Lake Peipsi are usually small and are therefore bought at lower prices. The prices of the major target species of Lake Peipsi have been relatively stable over the past five years: only the price of pikeperch rose significantly in 2010 (Figure 43).

From 2006–2009 the annual value of catches taken from Lake Peipsi ranged from 2.96 to 3.55 million euros, but increased to 4.34 million euros in 2010 due to an increase in perch catches. Pikeperch and perch catches accounted for the bulk of the value of the catch (total 90%) in each of these years; in other words, most of the revenue earned in Lake Peipsi fishery is generated from pikeperch and perch fishing (Figure 42a). App. one third of the total catch value comes from fishing with large-mesh gill nets; another third comes from fishing with trap nets (pelagic and fyke nets and lines of trap nets combined); and the remai third comes from fishing with demersal seines (Figure 42b). However, the proportion of fishing with seines has declined in recent years, while the importance of fishing with nets (in particular trap nets) has increased.

On average, fishing revenue has amounted to 8800 euros per fisherman over the last five years. After the deduction of expenses (usually half), app. 4400 euros a year could be paid as the fisherman's salary and taxes – which means that, at best, a fisherman earned half the average annual Estonian salary from fishing. Any additional wages had to be earned elsewhere.

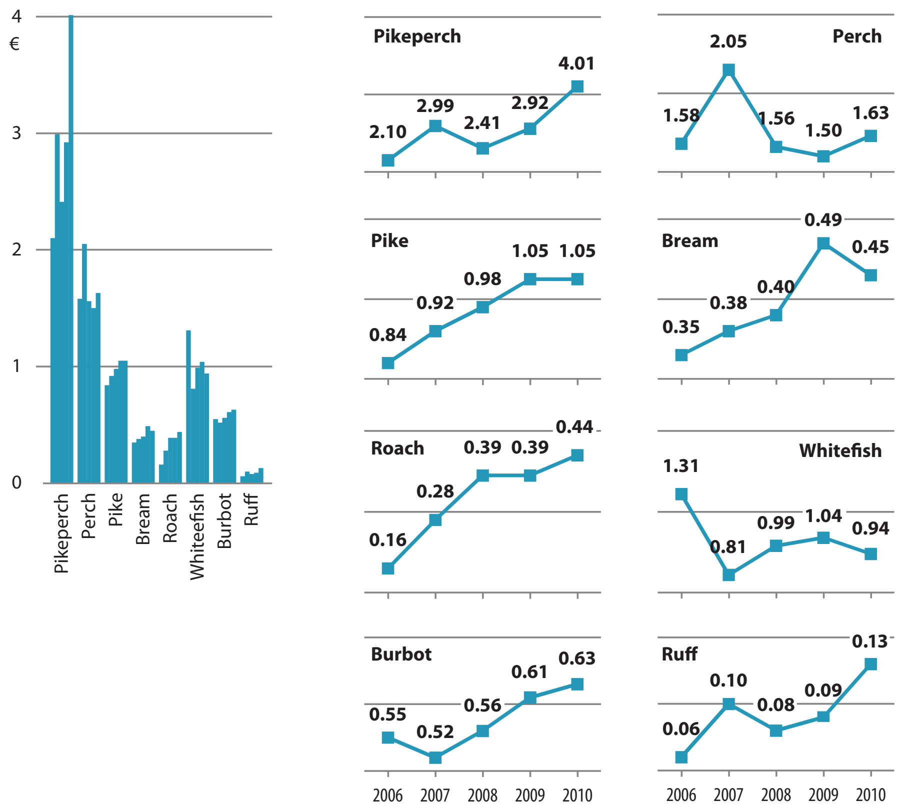


Figure 43. Average first sale prices (€ kg^{-1}) of major target species in Lakes Peipsi and Lämmijärv from 2006–2010. Source: MoA

Ports and vessels

Fish is landed in more than 30 places, but only two of them – Kallaste and Vasknarva – are properly built and registered ports. At Kallaste 500 or more tonnes of fish are landed annually; at six ports the landings range between 100 and 300 t; and at 14 ports these quantities range between 10 and 100 t. The rest of the ports receive less than 10 t of fish a year (Figure 44).

As at 1 July 2011, 318 fishing boats were registered in the Estonian Fishing Vessel Register. Their construction years ranged from 1951–2008. Most of them were older than 10 years (276 boats); the number of up to 10-year-old fishing vessels was just 42. While older vessels were mainly wooden (114 vessels) or metal (117 vessels), the main building material of newer vessels was fibreglass/plastic (24 vessels). The latter included new demersal seine boats (12 vessels) and trap net boats (5 vessels). More than 90% of fishing vessels used on Lake Peipsi (including all of the newer ones) were up to 12 m in length and with a gross tonnage of less than 10 t. The capacity of main engines was up to 220 kW, but engines with a capacity of 40–60 kW were more common.

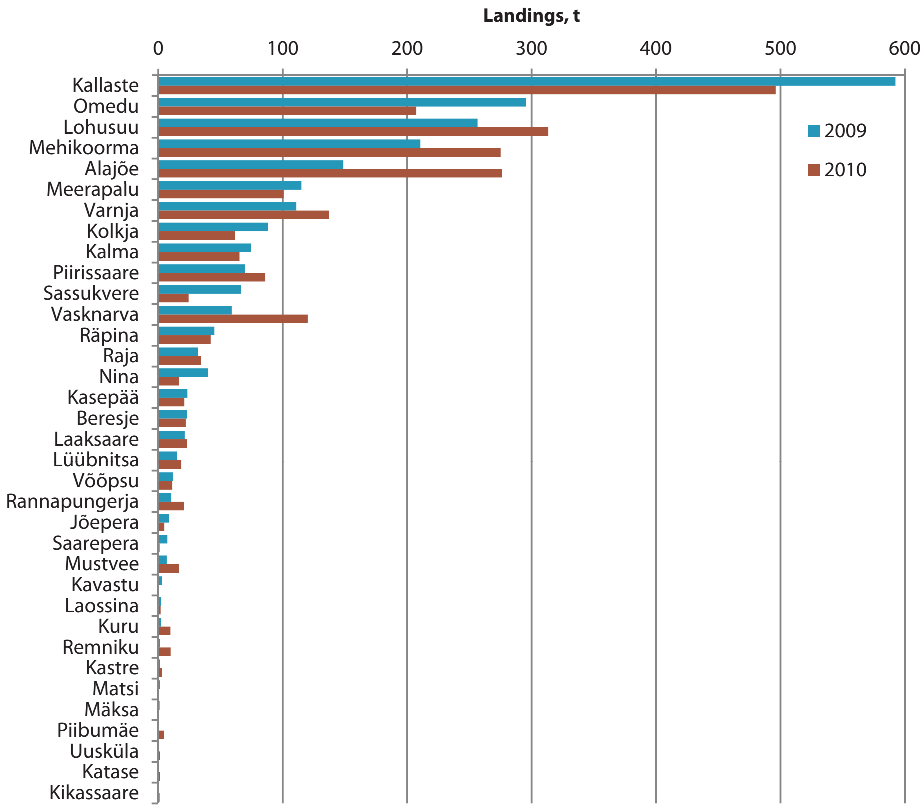


Figure 44. Fish landings (t) at ports of Lakes Peipsi and Lämmijärv in 2009 and 2010. Source: MoA

Processing and sales of fish

At least two-thirds of the fish caught from Lakes Peipsi and Lämmijärv are processed by companies situated around the lake, while the rest of the catch is marketed mainly through companies based in Pärnu. All six major fish-processing companies have been certified under EU requirements and are mostly oriented towards foreign markets (Latvia, Finland, other euro area countries and also North America). Some of the companies oriented towards the domestic market have also been licensed under EU requirements. The main export species of the lake – pikeperch and perch – are mostly marketed in the form of fillets. The assortment is wider in the case of other species (chilled, frozen, smoked and dried fish). Some lakeside companies prepare culinary products.

Grants

Lake Peipsi fishery has been supported with around 1.7 million euros within the scope of priority axis III of the National Development Plan 2004–2006 and under the Operational Programme of the European Fisheries Fund 2007–2013. Grants have so far mainly been used for the acquisition of new fishing equipment or modernisation of old fishing equipment (vessels, engines and navigation equipment), investments in the processing and marketing of fish and acquisition of dredging equipment (ARIB).

Problems and future

The main problems facing Lake Peipsi fishery (excluding poaching) are as follows:

1) the lake is not managed as a pikeperch lake; too many small-mesh traps are used which results in irrational exploitation of pikeperch stocks and may lead to a decline in stocks;
2) differences in the management of fish stocks by Estonia and Russia (preferences concer the use of fishing gear, allocation of quotas, monitoring, catch statistics and assessment of stocks); and
3) excess fishing capacity, lack of selectivity of fishing gear (especially as regards Danish seines or demersal seines) and the resulting reduction in the minimum size of pikeperch.

The following needs to be done to solve these problems:

1) in the management of the lake, more consideration should be given to natural processes;
2) all of the people involved in fishery (fishermen, local people, officials, politicians, monitoring specialists and researchers) should act with a greater sense of responsibility; and
3) in terms of fishery as a business, not as a means of solving social problems, the fishing capacity (fishing gear and fishermen) must be reduced (because fishing gear and vessels are improving, grants continue to be paid and recreational fishing is growing) or at least concentrated.

Also, the physical and ideological base of fishery research is outdated. To improve this situation, Estonia has found funds from the EFF.

Recreational fishing

An overview of recreational fishing in Estonia

Since 1 January 2006, the fisheries administration has been divided between two ministries in Estonia. The issuing of commercial fishing permits and management of catch data is organised by the Ministry of Agriculture, whereas the administration of recreational fishing permits is the responsibility of the Ministry of the Environment.

Organisation of recreational fishing

From 15 January 2001–31 December 2004, restricted fishing was distinguished in addition to the distinction between professional and recreational fishing. Restricted fishing implied a right to fish with a limited amount of commercial fishing gear. On Lakes Peipsi, Lämmijärv, Pskov and Võrtsjärv, such gear included up to three gill nets, one trap net with a mouth height of up to one metre or a bottom longline with up to 250 hooks. In other inland water bodies, restricted fishing gear included a gill net, a shore seine, a drag net, a hoop net, a trap net with a mouth height of up to one metre and a bottom longline with up to 100 hooks.

Until 2004 a recreational fisherman had to carry a fishing card that certified their recreational fishing right. These fishing cards were issued free of charge to persons entitled to a benefit. In addition, extra sheets of fishing cards were issued for regions where limitations on the number of persons wishing to fish, the amount of fishing gear or the fish to be caught applied under the relevant regulation of the Minister of the Environment. Thus, the number of extra sheets was limited and the sheets of fishing cards were issued free of charge. Fishing cards for 'specific' regions (for fishing salmon and sea trout and for under-ice whitefish fishing on Lakes Peipsi, Pskov and Lämmijärv) were introduced later. It soon became clear that such a system was too labour-intensive for the bodies issuing permits and sometimes complicated for the applicants. The need to issue fishing cards to persons whose free fishing right was certified by a document (pension certificate, student card etc.) which could have been submitted directly to an employee of the supervisory body was the most controversial. Creating the advantage of restricted fishing for landowners living near the waterfront was controversial as well, because such a natural resource should not belong to a very narrow group of people.

By amendments to the Fishing Acts which were adopted in December 2004, restricted fishing was included under recreational fishing. Restricted fishing gear became recreational fishing gear, with the exception of trap nets and shore seines, which may not be used by recreational fishermen. Fishing cards were given a new mea, and extra sheets were abolished. From 1 January 2005 there can be three types of recreational fishing depending on the fishing grounds and the fishing gear used:

1) *Line fishing under the everyone's right*. Everyone may fish, free of charge and without having applied for the right to fish, with one simple hand line on a public water body or a water body designated for public use, taking into consideration restrictions concer the permitted fishing seasons, fishing areas and species of fish.
2) *Recreational fishing with up to three hook gears*. Under this fishing right it is permitted to use spin reels, trolling lines, pulling devices, fly hooks, bottom lines (krunda and tonka), unanchored trimmers, hand lines and more than one simple hand line, as well as harpoon guns and harpoons and hooks. To obtain this fishing right, the charge for a recreational fishing right must be paid (by way of mobile payment, buying the permit on the www.pilet.ee website etc.). Pre-school children, children under 16 years of age, pensioners, unlawfully repressed persons and disabled persons are not required to pay this fee.
3) *Recreational fishing on the basis of a fishing card* in regions where limitations on the number of persons wishing to fish, the amount of fishing gear, the time of fishing or the fish to be caught apply for fish stock conservation purposes. This right also applies in regions where gill nets, longlines, hoop nets, drag nets, crayfish dip nets and traps may be used for recreational fishing. The maximum number of fishing cards is established by a regulation of the Minister of the Environment for each fishing year. A fee must be paid for a fishing card.

Number of recreational fishermen

It is difficult to determine the exact number of recreational fishermen in Estonia, for a number of reasons. Only some fishermen have to pay the fishing fee. Also, one person may acquire fishing rights for several shorter periods a year. The only requirements to be observed when issuing fishing cards are that not more than one fishing card is issued to a person in one region and that the maximum permitted number of cards determined for a region is not exceeded. However, this does not mean that the same person cannot obtain a fishing card for another region. Thus, there is no overview of the number of people using the free fishing right or of those who fish on the basis of a fishing card. Therefore, the number of recreational fishermen can only be assessed. The Ministry of the Environment estimates that there are app. 50,000 recreational fishermen in Estonia (Tuus, 2009). The actual number of people engaged in fishing, however, is probably somewhat smaller.

During the Soviet period, fishermen had to be members of professional associations and carry a fisherman's card. This ensured a good overview of the number of persons engaged in fishing. After re-independence, membership in associations was no longer mandatory and associations gradually terminated their activities. Fishermen's organisations began to emerge again later, but the number of fishermen belonging to associations is now significantly lower than in years past. At the end of 2008 around 500 people were members of fishing clubs or societies, representing about 1% of the estimated total number of recreational fishermen (Tuus, 2009).

The number of people engaged in recreational fishing has to date only been estimated on Lakes Peipsi and Lämmijärv (Vaino, 2004) and the Suur-Emajõgi River (Saar, 2009; Vaino, 2007). To assess the volume of recreational fishing on Lakes Peipsi and Lämmijärv, Vaino (2003) used the data of fishing card sales in the relevant counties (at the time, a fishing card gave a person the right to fish with hooks), the results of counting fishermen with the help of border guard officials, the results of anonymous surveys among fishermen and buyers of fish and measurement data on the main target species in recreational fishing (perch and roach). The most significant of these was a questionnaire that consisted of 16 questions and was distributed to 250 fishermen in Estonian and Russian. According to counts, there were more than 4000 visits per week to the lake at the end of winter 2003, compared to just 1000 visits per week during the summer.

The number of fishermen on the Emajõgi River depended on both the day of the week and the season (Saar, 2010). According to a count carried out along the river, there were more fishermen on the river at weekends than on working days. From September 2008–October 2009 the number of fishermen counted ranged from 81–240 on working days and from 93–308 on weekends. The average number of fishermen within that period was respectively 147 and 198 and thus the number of fishermen fishing on working days accounted for 74% of those fishing on weekends. In terms of fishing seasons, the highest number of fishermen was counted in April and June, while in July and August the numbers were lower. The number of fishermen increased again in September and October and in certain sections reached or even exceeded the level of spring. The above figures reflect only the number of fishermen at the river at the time of counting (app. four hours). The actual number of fishermen was higher. Thus, assuming that an average fisherman spends four hours at the river and the vast majority of fishermen fish from 9:00 to 21:00, the actual number would be three times higher. In this case, there would be 74,088 and 44,550 visits to the Emajõgi River from April to November (working days and weekends respectively). The accuracy of this assumption and the size of the average catch should be clear after the relevant study carried out by the South-Estonia Fishing Club and the Estonian University of Life Sciences from 2010–2012 is published.

Fishing fees

The fee payable for recreational fishing rights can be divided into two types, depending on the type of right acquired. The first is the standard charge for the right of recreational fishing with hooks (fishing cards were used in lieu of this until the end of 2004); the second is the charge payable for a fishing card. An overview of receipts of fees is available from 2004 onwards (Table 29). Since

Table 29. Proceeds from commercial and recreational fishing charges (10^6 €) from 2001–2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Commercial fishing										
Trawling	0.56	0.19	0.24	0.20	0.13	0.17	0.20	0.18	0.24	0.29
Coastal fisheries	0.46	0.38	0.42	0.41	0.30	0.33	0.22	0.31	0.35	0.32
Distant-water fisheries	0.42	0.28	0.50	0.38	0.36	0.27	0.29	0.46	0.41	0.23
Total commercial fisheries	**1.43**	**0.86**	**1.15**	**0.99**	**0.79**	**0.77**	**0.72**	**0.96**	**1.00**	**0.84**
Recreational fishing										
Fishing card*				0.12	0.11	0.10	0.13	0.23	0.17	0.15
Fee for fishing right**	0.18	0.19	0.22	0.20	0.22	0.28	0.29	0.29	0.38	0.36
Total recreational fishing	**0.18**	**0.19**	**0.22**	**0.31**	**0.33**	**0.38**	**0.42**	**0.52**	**0.54**	**0.52**
Total	**1.61**	**1.05**	**1.37**	**1.30**	**1.12**	**1.15**	**1.14**	**1.48**	**1.54**	**1.36**

* Data for 2004 still concern restricted fishing. There are no data on the receipt of fees before 2004.
** Fishing card until 31 December 2004.
Source: MoE

then there has been a rising trend of proceeds from recreational fishing fees (up to 2009, inclusive). In 2010 the proceeds from the fees for both fishing rights and fishing cards decreased slightly. The proceeds are expected to increase again in the coming years.

The Environmental Charges Act stipulates that proceeds from the use of renewable natural resources (such as fish stocks, forest stands and game) must be used for the restocking and protection of such resources. Therefore, proceeds from the use of the environment (including fishing) are transferred to the foundation that organises the use of the funds – the Environmental Investment Centre (EIC) – whose task is to grant the funds to various projects implemented under the fisheries programme. Grants can only be applied for by legal entities (non-profit organisations and foundations, research institutions, companies, businesses etc.). Over the past five years, around two million euros has been granted to fisheries projects annually. As proceeds from fishing fees are smaller than this amount, other environmental charges are used as well.

Catch data

As for recreational fishing, catch data must only be presented by those fishing on the basis of a fishing card. A report is submitted once, at the end of a catch period, per fishing card issued. A total of 15,784 reports were submitted in 2008, 12,594 in 2009 and 14,984 in 2010. The number of fishing cards issued in these years was 8500, 8261 and 8451 respectively. Fish quantities caught on the basis of fishing cards are set out in Table 30.

Overall, the quantities caught have been more or less the same over the years. The catch from inland water bodies in 2005 was an exception, exceeding the catches of subsequent years by more than two times. This was due to fisheries management in Lake Peipsi. Nearly three-quarters of inland catches from 2005–2008 were obtained from Lake Peipsi (Saat, 2010). Fishing with gill nets was closed from 15 May–31 August until the end of 2005. Thereafter fishing

Table 30. Quantities of fish (t) caught on basis of fishing cards from 2005–2010

Year	Catch, t		
	Baltic Sea	Inland water bodies	Total
2005	92.5	279.8	**372.3**
2006	86.6	93.4	**180.0**
2007	87.8	98.3	**186.1**
2008	88.1	105.9	**194.1**
2009	93.2	82.9	**176.1**
2010	97.1	96.8	**194.0**

Source: MoE

periods were limited significantly: in 2006 it was permitted to fish in spring and autumn, and since 2007 gill net fishing has only been allowed in spring.

In the sea, flounder is the most common target species in recreational fishing on the basis of fishing cards (caught mainly with gill nets and longlines), followed by perch, Crucian carp, whitefish, vimba bream and pike. Catches of salmon and sea trout have increased substantially in recent years as well. In terms of recreational fishing with nets, Lake Peipsi, Lake Võrtsjärv, Narva Reservoir and the Suur-Emajõgi River are the most important inland water bodies. Nearly half of the total catch of inland fishing with nets is taken from Lake Peipsi. Roach and perch make up the bulk of the catch; in 2005 pikeperch also had a large share. In Lake Võrtsjärv, pikeperch, pike, eel and bream are the main target species, whereas in the Emajõgi River bream and eel are caught the most.

The above figures do not reflect all of the quantities of fish caught by recreational fishermen. Various studies have been carried out to estimate the actual quantities caught. For example, Vaino (2003) has assessed recreational hook fishing catches from Lake Peipsi, conducting surveys and weighing catches. On average, a recreational fisherman caught 6 kg of fish from the lake per day. Hence, the catch of a fisherman amounts to 156 kg per year, taking into account the average number of fishing days spent on the lake. Thus, the annual catch of recreational fishermen from the lake is at least 500 t, including perch 283 t, roach 134 t, pike 34 t and other species 49 t. On the basis of the calculations made by Saar (2010) regarding the Emajõgi River, whereby the daily average catch of a fisherman amounts to 2 kg, the total annual catch is around 120 t, considering the total number of fishermen. On the Emajõgi River the catch of fishermen using hooks is several times greater than the total catch of fishermen using gill nets and longlines on the basis of fishing cards. According to Vaino (2007), less than one tonne of fish is caught from the Emajõgi River on the basis of fishing cards per year. A comparison of recreational fishing on Lake Peipsi and under-ice fishing in Pärnu Bay (Saat & Niidas, 2010) showed that perch and pikeperch were the main species in catches. In Pärnu Bay the daily catch of perch per fisherman amounted to nearly 4 kg and the daily catch of pikeperch was approximately 1 kg in 2005.

Although the number of people engaged in recreational fishing is remarkable, they still do not have an umbrella organisation. Attempts have been made to set one up, but largely on the initiative of a small group rather than a common desire of organisations uniting recreational fishermen. This is probably why these attempts have not been successful. Yet there is some interest, and the first steps have been taken. An advisory council for recreational fishing is being set up whose tasks will include determi strategic courses of action, analysing the implementation of the recreational fishing development plan, discussing key topics, popularising recreational fishing and developing joint activities. The latter will be the focus of attention when setting up the advisory council. The Estonian Fishermen's Society (EFS) existed until 1992, when its membership amounted to 57,000 people.

Aquaculture

Background and history of Estonia's aquaculture sector

Aquaculture is defined as the cultivation of aquatic organisms by humans in specific conditions where production exceeds the natural production of water bodies. Fish farming is a part of aquaculture. In addition to fish, freshwater crayfish is also cultivated in Estonia. Aquaculture has undergone rapid technological development globally, including in Estonia. Although there are still a few fish farming facilities in Estonia which originate from the Soviet era, the main production is provided by fish farms that use intensive technology. Estonian fish and crayfish farms vary very much according to their size, intensity and purpose. Intensive commercial fish farms give the economically most important part of production. In addition, there are numerous owners of small ponds who farm fish or crayfish for fun or to obtain additional income and develop angling tourism. Besides the production for consumption juvenile salmon, trout and eel are produced in some fish farms. Crayfish farming is a domain of its own. The situation is not comparable with the end of the Soviet period, when more commercial fish were farmed than now during the short period of 1987–1990 (up to 1740 t), but production efficiency as well as quality and marketing of production were completely different at the time. There were 30 large fish farming enterprises in Estonia in 1989 which had 44 fish farming facilities in 44 locations. In 2010 there were around 20 major operating companies for which the cultivation of aquatic organisms was a significant line of activity. 15 rainbow trout farms (by location), three carp farms, one eel farm, one sturgeon farm, two state finances farms for the cultivation of salmonids for restocking material and five crayfish farms operated in Estonia in 2010. Estonian aquaculture is characterised by high fragmentation of many small-scale production methods and products. Some farms are simultaneously engaged in several areas: commercial fish farming, angling tourism and farming fish for restocking purposes.

In addition to operating fish farms, new farms have been created with support from the European Fisheries Fund which have not yet reached the stage of sales of production. There are over 60 fishing tourism businesses that offer angling services and buy fish from commercial fish farms. These businesses fall into two categories: those that focus on quick servicing of passing tourists and those that offer fishing opportunities alongside farm tourism services. Estonia has a large number of small-scale fish farmers (over 200) whose production capacity is just a couple of hundred kilograms or a few tonnes, but some of them have been registered as fish farming businesses. The number of fish farms varies even within years, as some farms go out of business, while others begin construction activities but have yet to sell their production.

Commercial fish farming

Fish farming production from 1992–2010, based on official statistics, is presented in Table 31. However, the data of the Estonian Fish Farmers Association show that the official figures are often different from actual production. The production of rainbow trout has been higher and more stable than reflected in official statistics. Prominent lows derive from the fact that some major producers have occasionally failed to submit data. The lower production in 2010 resulted from an exceptionally hot summer, which caused massive losses in the rainbow trout farms of the largest producers. Errors in the data can also occur because of the fact that production sold by different companies to each other may have been taken into account several times. As production and sales periods do not coincide with calendar years, there are large fluctuations in production data, such as differences between the quantities of fish farmed and sold. Official statistics take into account the small quantities (200 kg) of additional fish (such as pike, perch and Crucian carp) obtained when fish ponds are discharged, but aggregate the species that give substantial production and are novel in Estonia in the row marked 'Other'. 'Other' includes, first of all, two species of the Acipenser family (Siberian sturgeon and Russian sturgeon) whose production amounts to around 40 t, and experimentally also Arctic char, tilapia, striped bass and whitefish. According to the data of Statistics Estonia, approximately less than 100 full-time employees have been engaged in Estonia's commercial fish farms for many years. The quantities of fish farmed in Estonia in the last 10 years range from 200–800 t per year. In recent years production of large rainbow trout has increased as a consequence of setting up new farms or reconstruction of old farms with the support of EU funds. However, demand of this product by Estonian domestic market and processing companies for raw materials are greater. The Fish Farmers Association and the Estonian Institute of Economic Research estimated in 2009 that domestic consumption of large red flesh salmonids (salmon, trout and rainbow trout) may exceed 2000 t, of which local production currently covers less than half. Therefore, products imported from Norway prevail and meet the needs of fish processors and traders. The potential production capacity of currently operating carp farms (without the use of industrial hot water) is less than 100 t. The sales of carp on foreign markets are limited by transportation

Table 31. Estonian fish farming production (t) from 1997–2010

Species	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Rainbow trout	227	285	147	313	412	287	304	394	451	520	622	649	790	584
Carp	28	23	30	47	52	53	51	47	44	80	28	70	74	61
Eel						12	15	7	40	40	45	47	30	30
Other fish*	5	1	0	0	2,7	1,4	2	2,8	16,7	62,2	83,2	45,8	66,2	84,3
Total	**260**	**309**	**177**	**360**	**467**	**353**	**372**	**451**	**552**	**702**	**778**	**812**	**960**	**759**

* sturgeon, perch, pike, Gibel carp, tilapia, striped bass, char, etc.

Source: Statistics Estonia

problems, because carp is mostly marketed in the form of gutted raw fish. Carp farms focus on meeting domestic demand and selling of restocking material to small-scale fish farmers. Eel production exceeds 40 t, most of which is exported.

The production of sturgeon (Siberian sturgeon and Russian sturgeon) has been usually less than 40 t. Exports of farmed freshwater crayfish have been limited due to losses resulting from a crayfish plague and do not exceed one tonne. It is difficult to conduct an economic analysis of Estonian fish farming sector, as statistical data are deficient. Since there is no organisation uniting all aquaculture producers, and many major producers are not members of the Estonian Fish Farmers Association, there is no complete overview of the sales and product prices of fish farms. Fish farmers sell a variety of products: live fish as restocking material or for 'put-and-take' ponds, as well as gutted and processed fish. Prices vary from season to season, from region to region and from year to year. The sales of the sector are estimated to amount to around five million euros annually.

Fish farming for restocking purposes

The restocking of farmed juvenile fish into natural water bodies is regulated by the Programme for Protection and Restocking of Endangered Species Requiring State Protection 2002–2010, which will be updated in 2011/2012. Only native species may be released in natural water bodies in Estonia. Fish farmers who produce fish for restocking are demanded to maintain biodiversity and not to mix genetically different populations. To enhance fish resources juveniles of eight fish species (salmon, sea trout, brown trout, whitefish, pike, eel, tench and pikeperch) and crayfish were farmed for restocking water bodies from 2002–2010. Since 2007 efforts to produce restocking material of asp, a protected species, was started by releasing the first fry into the Suur-Emajõgi River. Restocking of brown trout, whitefish, pike and pikeperch has been stopped or decreased in recent years. Restocking of salmon, trout and eel was financed mainly by the state through the Environmental Investment Centre. In 2010 there were two fish farms in Estonia exclusively engaged in the production of salmonid stocking material: Põlula Fish Farming Centre (a state enterprise) and OÜ Õngu Noorkalakasvandus. The Härjanurme Fish Farm, Riina Kalda's fish holding Carpio and OÜ Ilmatsalu Kala have produced some fish for stocking. AS Triton has stocked eel. Salmon introductions have been successful. Stocked salmon have been returned to the Selja, Pirita, Purtse and Valgejõgi Rivers and spawned there, which indicates that the salmon populations of these rivers can be restored. In coastal fishing in the Gulf of Finland, stocked salmon have accounted for over 70% of the total catch in some regions. The recapture of stocked salmon individually marked by the Põlula Fish Farming Centre was, at best, up to 5% in 1998 and 1999; later less than just 1%. This may be due to changes in ecosystem and food basis of the Gulf of Finland which are now unfavourable for juvenile salmon. Similar trend has been found in Finland. Trout introduced by the Õngu Fish Farm in the coastal waters of Hiiumaa accounted for more than 75% of the catch in the Õngu Stream from 1995 to 2007. New populations have been created in Estonia by restocking of brown trout.

Crayfish farming

Estonia is one of the few countries in Europe which, until recently, had only indigenous crayfish – *Astacus astacus* – and where it was prohibited to introduce and cultivate any other species.

Crayfish farming was started on the basis of native crayfish. In the Nordic countries the price of crayfish is higher than that of other crustaceans, because it is tastier. Thus, hopes for marketing of Estonian crayfish were high. However, crayfish farming is endangered by crayfish plague. Outbreaks of this disease have destroyed populations of Estonian crayfish farms. In recent years, signal crayfish, a North American species, has been found in two areas in Estonia. This crayfish is not sensitive to the plague and may spread the disease. Current official statistics on crayfish farming include errors. For example, unit-based data submitted by crayfish farmers have sometimes been recorded as kilogram-based data. Exports of farmed commercial crayfish have been limited due to losses resulting from diseases and do not exceed one to two tonnes. Therefore, data on crayfish farming have been removed from Table 31 on aquaculture production.

Prospects for development of aquaculture in Estonia

Unlike in fishery, natural resources do not constitute a limiting factor in the development of fish farming in Estonia. Compared to other EU Member States of a similar size (such as the Netherlands and Denmark), there is enough water and vacant land in Estonia. Different types of technology can be used (flow through or re-use of water) and species that are novel in our fish farming (eel, sturgeon, Arctic char, whitefish, pikeperch and decorative carp i.e. koi), as well as exotic warm-water species such as striped bass, tilapia and barramundi have been tested. Permission of the MoE is sought for such experiments. This permission is based on expert opinions. So far, only eel farming has been successful.

Integration with the European Union since 2004 has had positive effect on the development of fish farming. All of the rainbow trout stocking material and the feed necessary for rearing it is currently imported from Denmark and other European countries. Carp farming is following the same course, as cheap carp stocking material and fish feed can be bought from Latvia, Lithuania, Poland and Hungary. Fish species that are new in Estonian fish farming are predominantly imported as stocking material and are not reproduced here. Opportunities have been sought to export production. In the case of some species (eel and crayfish), most production is exported. Lack of investment capital and know-how are the main factors that are restricting the development of fish farming in Estonia. Fish farms are currently of the family farm type. The owner is both the managing director and the fish farmer, whose knowledge and financial capacity determine the success of the business. The establishment of new fish farms through investments by large companies is also being hindered by the lack of proficient farmers. Fish farmers have been taught at the Estonian University of Life Sciences since 2002, but so far only 13 students have graduated with a Master's degree. The small production volume cannot grant a regular, year-round supply for large store supermarket chains or attract the interest of exporters. The relatively high production cost makes it difficult to compete with similar products imported from Norway. Weakness in producers' joint activities limits possibilities of organising marketing and trai. The Estonian Fish Farmers Association, a non-profit organisation established in 1989, does not unite all fish farming businesses, but rather people interested in fish farming. However, the association has been a key partner for the state in negotiations on issues concer the development of fish farming (e.g. the use of EU funds and legislation on fisheries), it is represented in decision-making bodies and has organised the exchange of information between fish farmers and trai in the area of fish farming.

Aid from the EU, granted e.g. under the pre-accession instrument SAPARD, the Financial Instrument for Fisheries Guidance (FIFG) 2002–2006 and from the European Fisheries Fund (2007–2013), has enabled new fish farming businesses to be set up and a number of old facilities to be modernised. Investment support can significantly increase aquaculture production in Estonia. The production of up to 2500 t in 2013 as a strategic goal will nevertheless be difficult to achieve.

Estonian fish processing industry in 2010

General overview of sector

According to the data entered in the Commercial Register, there were 52 companies in Estonia in 2010 whose main business comprised the processing and can of fish, crustaceans and molluscs. Based on the Commission Recommendation (2003/361/EC) concer the definition of the size of companies (2003/361/EC)[3], 85% of the companies were small, with an average number of employees of up to 49. A more detailed overview of the number of companies in different size classes is shown in Figure 45. The average[4] aggregate number of employees was 1860. The majority (65%) were women. Looking at the age structure of the companies, 34 (65%) of the 52 companies operating in 2010 were more than ten years old. Sales revenue of the companies amounted to 111 million euros during the year. Thirteen companies were engaged in the processing and can of fish, crustaceans and molluscs as auxiliary activities. Sales revenue from this segment amounted to 1.1 million euros. According to the contact details entered in the Commercial Register, most of the companies engaged in the processing of fish in 2010 operated in Harju and Pärnu Counties, accounting for 32% and 26% of the total number of companies respectively (Table 32).

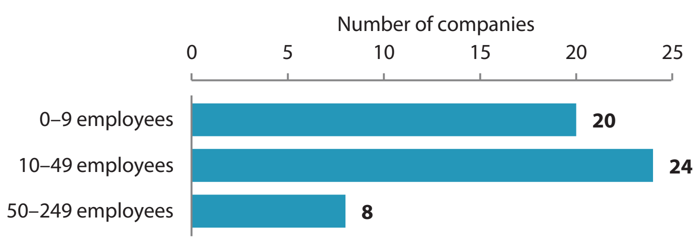


Figure 45. Number of companies whose main business comprised processing and can of fish, crustaceans and molluscs based on average number of employees. Source: Commercial Register

3 Commission Recommendation (2003/361/EC) divides companies into four groups based on the number of employees:
- *microenterprises* – 0 to 9 employees
- *small enterprises* – 10 to 49 employees
- *medium-sized enterprises* – 50 to 249 employees
- *large enterprises* – 250 or more employees

4 Average number of full-time employees (full-time equivalent)

Table 32. Number of companies engaged in processing of fish in 2010 broken down by county

County	Number of companies
Harju County	21
Pärnu County	17
Ida-Viru County	7
Tartu County	7
Saare County	6
Jõgeva County	4
Lääne County	2
Lääne-Viru County	1
Total	**65**

Source: Commercial Register

Basic and economic indicators in 2010 and trends of companies whose main business is fish processing

Compared to 2005, the number of fish processing companies had decreased by 20% by 2010 i.e. from 65 to 52 (Table 33). A similar decline was also observed in the number of employees. From 2005–2010 the average number of people employed in the fish processing industry dropped by 724 (28%), i.e. from 2584 to 1860. Nevertheless, the total sales revenue of fish processing companies has been fairly constant over the last six years, ranging from 99–124 million euros. In 2010 the average annual gross salary per employee was 6395 euros, up by 41% compared to 2005, but 7% less than in 2008.

Of the 52 fish processing companies, 17 (33%) closed the financial year 2010 with a loss. However, the fishing processing industry earned a net profit of four million euros and provided added value of nearly 21 million euros. The combined assets of fish processing companies amounted to 76.4 million euros in 2010, with fixed assets accounting for 58% (44 million euros). Investments placed in fixed assets during the year amounted to 10.6 million euros, which is more than in previous years. A positive trend over the last six years can also be

Table 33. Basic and economic indicators of companies whose main business is fish processing, 2005–2010

	2005	2006	2007	2008	2009	2010
Number of companies	65	55	57	59	56	52
Sales revenue, 10^6 €	101	110	99	124	110	111
Average number of employees	2584	2360	2097	2101	1822	1860
Average gross salary per employee, €	4533	4880	6221	6909	6447	6395
Value added, 10^6 €	20.7	19.7	17.7	25.2	22.9	20.9
Investments in fixed assets, 10^6 €	6.2	3.5	6.3	7.7	5.4	10.6
Debt ratio (%)	57	57	55	54	53	49

Sources: Statistics Estonia, Commercial Register

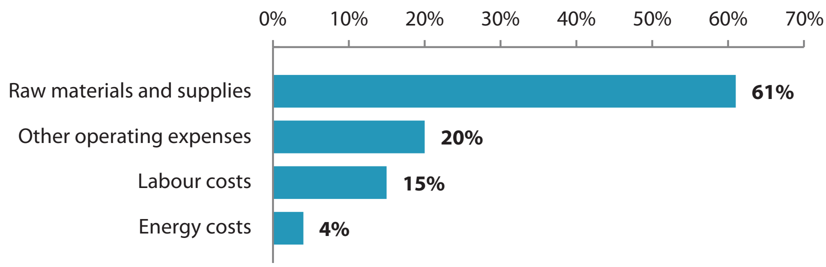


Figure 46. Percentage breakdown of aggregate operating expenses of companies whose main business is fish processing, 2010. Source: Commercial Register

seen in the decline of the share of liabilities (external finance) in the funding of the assets of companies as expressed by the debt ratio. The debt ratio indicates the share of a company's assets funded on account of borrowed resources. The decline of the debt ratio implies a decrease in the risk level of a company.

The operating expenses of fish processing companies totalled 106 million euros in 2010. Raw materials and supplies accounted for the largest share (61%) of expenses. The shares of labour and energy costs in operating expenses were 15% and 4% respectively (Figure 46).

If we compare the basic and economic indicators in the different size classes of fish processing companies (Table 34), it appears that almost 62% of the total sales revenue of the fish processing industry in 2010 came from eight medium-sized companies, which accounted for just 15% of the total number of companies. This size class also employs the highest number of people (58% of the total number of employees) and has the highest wage costs per employee. The amount invested in fixed assets in 2010 was more or less of the same order of magnitude of 3.3–4 million euros in all three size classes. 54% of total added value was produced by medium-sized enterprises. Based on the debt ratio, microenterprises were characterised by the highest risk level. The total operating

Table 34. Basic and economic indicators in different size classes of fish processing companies in 2010

Size class	Number of companies	Sales revenue, 10^6 €	Average number of employees	Average gross salary per employee, €	Fixed assets, 10^6 €	Investments in fixed assets, 10^6 €	Value added, 10^6 €	Debt ratio (%)
0–9 employees	20	6.4	85	5641	5.2	3.3	1.3	60
10–49 employees	24	36.2	692	5912	17.4	4	8.3	41
50–249 employees	8	68.3	1083	6762	21.4	3.3	11.3	53

Source: Commercial Register

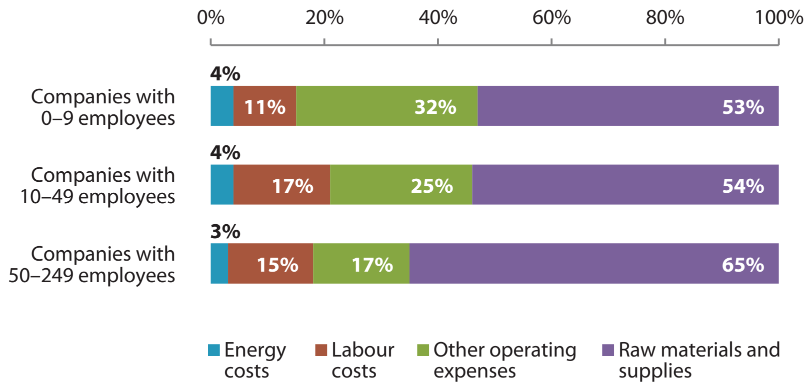


Figure 47. Percentage breakdown of operating expenses in different size classes of fish processing companies in 2010. Source: Commercial Register

expenses of fish processing companies (106 million euros) were divided as follows in 2010: microenterprises – 5.7 million euros; small enterprises – 33.4 million euros; and medium-sized enterprises – 66.9 million euros. The percentage breakdown of the operating expenses was broadly similar in different size classes (Figure 47). A higher proportion of costs of raw materials and supplies in medium-sized enterprises and a lower proportion of labour costs in microenterprises can be observed.

Production and sales

The production of the Estonian fish processing industry amounted to nearly 70,000 t in 2010. Frozen fish, salted, spiced and dried fish, deep-frozen fish and breaded fish accounted for the bulk of production (Table 35).

While the production of the fish processing industry has remained at more or less the same level over the last four years, it has declined substantially compared to earlier years. The most significant change has occurred in the production of fish preserves. The high point of fish preserve production during the

Table 35. Production (10^3 t) of Estonian fish processing industry by product type from 2006–2010

Fishery products	2005	2006	2007	2008	2009	2010
Fresh and chilled fish meat, fish fillets, minced fish meat	4.1	5.4	3.5	3.3	4.1	3.7
Frozen fish	40.3	40.3	36.5	30.3	34.6	35.0
Smoked fish	3.3	3.1	3.6	3.8	3.2	1.4
Salted, spiced and dried fish, deep-frozen fish and breaded fish	27.4	27	24.4	20.8	25.1	19.9
Culinary fishery products in oil, marinade or sauce	1.3	1.3	2.9	1.5	1.7	1.4
Fish preserves	9.7	7.4	5.1	7.1	3.6	5.1
Total	**86.1**	**84.5**	**76**	**66.8**	**72.3**	**66.5**

Source: Statistics Estonia

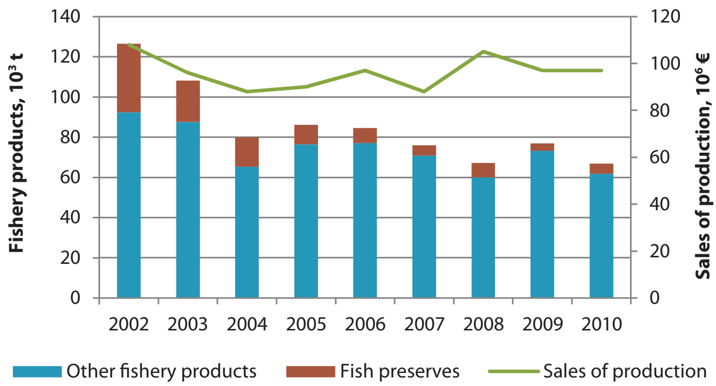


Figure 48. **Dynamics of production and sales revenue of fish processing industry from 2002–2010.** Source: Statistics Estonia

post-independence period was 1997, when the volume was 13 times higher than in 2010, amounting to 68,000 t. This remarkable decline has been caused in particular by the unstable situation in the eastern market as well as by reduced demand for traditional fish preserves. Sales revenue of the fish processing industry amounted to 96 million euros in 2010. Although production has generally declined since 2002, the value of the production sold has remained at more or less the same level, which can be explained by price increases (Figure 48).

On average, the proportion of exports in sales has accounted for 75% over the last 10 years, which indicates the high dependence of the Estonian fish processing industry on exports. In 2010 this figure was 75.2% (Table 36). In 2010, fish processing companies exported their products to 36 countries to a value of 72 million euros, which represented 51% of the total exports of fish and fishery products (142 million euros).

By production characteristics, sources of raw materials and orientation towards foreign markets, Estonian fish processing companies can broadly be divided into four groups:

- *producers of frozen fish* – Baltic Sea sprat and herring are the raw materials

Table 36. **Domestic sales and exports of production of fish processing companies from 2005–2010**

Indicator	2005	2006	2007	2008	2009	2010*
Total sales, 10^6 €	90	97	88	105	97	96
Domestic market, 10^6 €	27	24	24	27	25	24
Exports, 10^6 €	63	73	64	78	72	72
Share of exports (%)	69.6	75.4	72.8	74.1	74.2	75.2

Sources: Statistics Estonia, *Commercial Register and the production is sold on the eastern market (Russia, Ukraine, Belarus etc.);

- *producers of fillets and culinary products* – imported and local fish are the raw materials and the production is sold on the western market (Switzerland, Germany, Denmark, Finland, Sweden etc.);
- *producers of fast-food* – the raw material is imported and the products are sold on both the eastern and western markets (Lithuania, Serbia, Finland, the Czech Republic etc.); and
- *producers of fish preserves* – fish from both the Baltic Sea and oceans are the raw materials and the products are sold predominantly on the eastern market (Russia, Ukraine, Kazakhstan, the Czech Republic etc.).

Table 37. Top ten countries in total exports and imports of fish and fishery products in 2010. In addition to local production, the table also includes the fish and fishery products that passed through Estonia

Export country	Quantity, 10^3 t	Import country	Quantity, 10^3 t
Russia	41.84	Latvia	9.85
Ukraine	36.43	Finland	5.58
Belarus	6.41	Lithuania	5.44
Kazakhstan	4.72	Denmark	3.00
Latvia	4.02	Canada	2.63
Finland	2.90	Sweden	2.39
Moldova	2.79	Norway	1.53
Denmark	2.78	Russia	0.79
Lithuania	2.69	Vietnam	0.75
Croatia	2.61	Germany	0.64

Source: Statistics Estonia

Table 38. Amounts paid in 2010 within the scope of fisheries aid

Aid	Amount paid, €
Investments in processing and marketing of fish (measure 2.3) – the aid is designed to develop and modernise the processing of fishery products or aquatic plants.	**1 976 605**
Collective investments by producer organisations (measure 3.1.1) – the aid is designed to improve the quality of fishery products and increase year-round stability of supplies through the development of producer organisations.	**4 720 747**
Development of new markets and promotional campaigns (measure 3.4) – the aid is designed to promote the consumption of fishery products and new products and find new market outlets for fishery and aquaculture products.	**437 688**
Practical trai support for producers or processors of fishery products – the aid is designed to partially compensate producers or processors of fishery products for the costs of practical trai of students in fisheries-related disciplines which is arranged in the enterprises of the producers or processors.	**32 170**
Trai support for producers or processors of fishery products – the aid is designed to partially compensate producers or processors of fishery products for the costs of trai of the producers or processors or their employees.	**4990**

Source: ARIB

Occasional problems occurring in sales of production on the eastern market have made many companies oriented towards the eastern market more cautious. Therefore, efforts are being made to find additional markets so as to diversify risks. The production of all four groups is also represented on the local market.

In 2010 fish and fishery products ware mainly exported to Russia, Ukraine and Belarus, while the main import countries were Latvia, Finland and Lithuania (Table 37).

Aid

In 2010, fish processing companies and producer organisations received fisheries aid in the total amount of around 7.2 million euros (Table 38). Investment support was aimed at improving refrigerating systems, constructing new production facilities, acquiring production lines and equipment and waste management.

Estonia’s fish market

In 2011 the Ministry of Agriculture commissioned a study of fish and the fishery products market of Estonia from the Estonian Institute of Economic Research (EIER) which aimed to analyse the market for fish and the volume and trends of consumption in Estonia. The study included the following stages: analysis of fishing capacity; analysis of production of fishery products; foreign trade (exports and imports) of fish and fishery products; preparation of a fish market balance; monitoring and analysis of retail supply of fish and fishery products; and consumption of fish and fishery products. To analyse consumption expenditure and volumes, the EIER used the household survey data of Statistics Estonia. In addition, the EIER conducted a nationwide survey in March 2011. Residents of all counties of Estonia (a total of 1127 people) responded to the survey.

The following is a summary of the key findings and conclusions of the study.

Fishing and resources

- Fishing per capita has decreased in the last 10 years: in 2010 Estonian fishermen caught 71.2 kg of fish per inhabitant (72.8 kg in 2009, 74.2 kg in 2008 and 74.1 in 2002).
- Estonia’s main fish resources consist of the Baltic Sea sprat and herring and, to some extent, also the fish of inland water bodies (perch, pikeperch etc.). Exports of frozen sprat and herring have increased in recent years, while the local fish resources of the domestic market have declined (consumption has dropped from 25,700 t of sprat and herring in 2007 to 10,500 t in 2010).
- Thus, the Estonian fish market is characterised, on the one hand, by extensive exports of Estonian resources (sprat and herring) to low-priced markets (Russia and Ukraine) and, on the other hand, by the orientation of domestic consumption and production to other, imported fish (salmon, trout, Atlantic herring, hake, mackerel and other species).

Foreign trade

- Frozen fish makes up three-quarters of Estonia’s fish exports. By quantity, Estonia’s three main fish export items are frozen sprat, frozen herring and frozen shrimp. By export value, the top three articles sold to foreign markets are frozen shrimp, frozen sprat and chilled perch and pikeperch fillets. In terms of both quantity and value, sprat and herring products (canned products and preserves, incl. sprats) prevailed among the products sold to foreign markets. In terms of quantities of fish sold, Russia is the largest export market for Estonia (mostly frozen sprat and herring). Fishery products (including preserves and culinary products) were exported to Ukraine the most (around two-thirds of Estonia's exports of spiced sprat).

- Frozen shrimp is Estonia's major import article in terms of both quantity and value. Frozen shrimp was followed by frozen Atlantic herring and chilled sprat in terms of quantity, and by chilled and frozen red meat fish in terms of value. By quantity, sprat and Atlantic herring products prevailed among the fish preserves and other products brought to the Estonian market. The most fish and fishery products were imported from Latvia. Imported salmon usually originates from Norway; trout is also imported from Finland, Sweden and Latvia.

Fish processing industry

- In terms of quantity, the production of fish processing companies (companies engaged in processing and preservation of fish and fishery products) has decreased over the last eight years (since 2003), mainly due to the decline in the production of fish preserves. For fish processing companies the decrease in the quantity of fishery products has partly been offset by price increases; as such, sales revenue has declined less than the quantities produced. In terms of quantity, production is dominated by frozen fish (sprat and herring), followed by spiced fish. The largest share of sales revenue is earned from fish fillets and chopped/sliced fish meat, followed by preserves and culinary products, breaded products (fish fingers, burgers etc.) and frozen fish. Nearly three-quarters of the fish processing industry's production continues to be exported, and the domestic market is of marginal importance for many large companies.
- Freshwater fish fillets (perch and pikeperch) are mainly exported to Switzerland, Germany and Denmark; salmonid fillets and other salmon products are marketed in Finland and Sweden; and frozen sprat and herring are exported to Russia, Ukraine, Belarus and Kazakhstan. Fish preserves are sold primarily in Ukraine, Russia and other Eastern European markets, while shrimp are exported to Denmark.

Retail trade

- The assortment of fishery products in stores was slightly wider in 2011 than in 2003, but this was due to imported products. The range of local products had decreased. While in 2003 the products of Estonian producers prevailed in stores, in 2011 the assortment was dominated by imported products (in all types of stores except markets).
- In total, 1772 different fish and fishery products were counted in stores and

on markets during the survey (+14% compared to 2003)[5]. Of these, 43% were from Estonia (in 2003 local products made up 62% of the assortment).

- Fish preserves and culinary products comprised the product groups characterised by the widest assortment, each contai over 370 articles. The assortment of fresh fish was wider on markets than in stores, incl. as regards the choice of fish from Estonian waters. Stores which are smaller than supermarkets usually do not sell fresh fish (the same applies to most stores in rural areas).
- As regards imported fishery products, the assortment of frozen fish, fish preserves and surimi products (crab sticks) has increased in stores. As for local production, only the range of seafood (shrimp) has increased. The presence of domestic fishery products depends on the owners and price range of the retail chain in question. For example, in Selver stores and the stores of the Central Society of Estonian Consumers Co-operatives (CSECC), domestic products accounted for over half of the assortment, whereas in discount stores (Maxima and Säästumarket) domestic products made up around a third of the product range. As for companies, the assortment in stores is dominated by products of the Viciunai Group (Lithuania) whose production accounted for a fifth of the average total assortment of a store if the production of AS Paljassaare Kalatööstus (belonging to the group) was taken into account (and a seventh if the production of AS Paljassaare Kalatööstus was not taken into account).
- Among Estonian companies, Viru Rand OÜ, M. V. Wool AS and Paljassaare Kalatööstus AS occupy the most prominent places in the assortment, followed by Ösel Fish AS, Kõrveküla Kalatööstus AS and Kirde Rand AS. Other trademarks and companies are less noticeable. As for fresh fish, trout and salmon prevailed (available in more than 80% of stores), whereas markets also offered herring, pikeperch, pike (available at 80% of markets), bream and eel (available at 60% of markets). In February 2011 a total of 31 species of fish could be bought fresh. Compared to 2003, the availability of fresh domestic fish (carp, flounder, pikeperch, pike, bream, perch, cod etc.) has improved significantly. As for frozen fish, the share of fish caught from Estonian waters and the Baltic Sea (flounder, herring and cod) has increased. A total of 35 fish species was available, with most stores also selling hake, pollock and pangasius.
- Salted Atlantic herring and spiced sprat, predominantly the production of Estonian companies, are sold in all stores. Nearly a third of all fishery products sold were imported from Latvia and Lithuania (these products also account for more than half or 53% of imported articles). Also, fish caught from more distant waters are sold under Lithuanian trademarks. The assortment of fish preserves imported from Latvia included 161 items, whereas the number of items in the assortment of domestic fish preserves was 58.

5 Products with the same name but from different producers were recorded as separate items; products of the same producer with the same name but in different packages were recorded as the same item.

- A product-to-product comparison of prices showed that for the majority of sale items the average prices of imported products were lower than these of domestic products. Fish and fillets, especially fish caught from Estonian waters, can be bought at much lower prices from markets than stores (Figure 49).

Consumption of fish

- The consumption of fish and fishery products has declined in recent years. The quantity of fish and fishery products consumed per capita was 12.1 kg in 2007 and 10.5 kg in 2010 (according to the household surveys of Statistics Estonia) (Table 39).
- In the five years from 2006–2010 the average consumption of fishery products amounted to 11.7 kg per year, down by 2.6 kg from the level in the years 2001–2005 (14.3 kg per year).
- According to official data, the consumption of self-caught fish and fish obtained free of charge has declined as well (from about 1.9 kg per year from 2001–2005 to about 1.0 kg per year from 2006–2010).

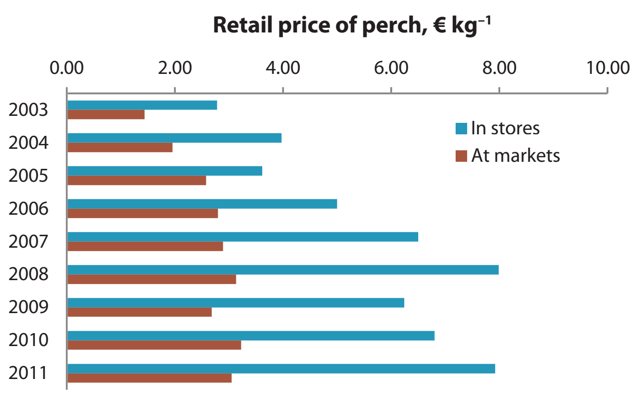


Figure 49. Retail price of perch from 2003–2011

Table 39. Average annual consumption of fish and fishery products per capita (household member), (kg)

	1996–99	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
By weight of product												
Purchased	12.3	13.3	13.0	13.3	11.9	12.6	11.6	10.6	11.0	11.7	10.5	9.9
Non-commercial consumption	2.1	2.2	1.6	1.8	2.0	2.5	1.4	1.2	1.1	1.0	0.8	0.7
Total	**14.4**	**15.5**	**14.6**	**15.1**	**13.9**	**15.1**	**13.0**	**11.8**	**12.1**	**12.7**	**11.2**	**10.5**
By weight of fish												
Purchased	13.5	14.7	14.4	14.9	13.5	13.8	13.0	11.9	12.2	12.8	11.6	10.9
Non-commercial consumption	2.2	2.3	1.7	1.9	2.1	2.5	1.4	1.3	1.2	1.1	0.8	0.7
Total	**15.7**	**17.0**	**16.1**	**16.8**	**15.5**	**16.3**	**14.4**	**13.2**	**13.4**	**13.9**	**12.4**	**11.6**

Source: Statistics Estonia; 2008–2009 – EIER

- The consumption of fresh fish has decreased the most, whereas the consumption of other fishery products has remained more or less the same over the last six years. The consumption of salted fish has increased slightly in recent years. Expenditure on fish increased until 2008, and dropped during 2009 and 2010. In 2010, the average annual amount spent on fish and fishery products was 498 kroons or 32 euros per capita. Due to the economic downturn, the consumption of other basic foodstuffs declined in 2009 and 2010 as well. The share of fish and fishery products in Estonians' expenditure on food has remained relatively constant within the range of 4.0–4.9% over the last 10 years. This share increased gradually until 2007 (to 4.9%) before dropping to 4.2% by 2010.
- The consumption of fresh fish varies markedly by region. For example, an inhabitant of Hiiumaa spends twice as much on fish as an inhabitant of Valga County. People living in coastal regions consume far more fresh fish than inland inhabitants (8.2 kg of fresh fish in western Estonia vs. 3.1 kg in central Estonia per capita).
- Younger people consume a lot less fish than older people. People of 60 years of age and older spend almost twice as much on fish as people under 40 years of age. The share of expenditure on fish in overall expenditure on food is higher among people with a higher income. The consumption of fish is limited by its price. According to the data of the EIER, retail prices of herring, perch and pikeperch have risen faster over the past five years than food prices as a whole.
- Fluctuations in world prices have a significant impact on the retail price of fish (demand for perch and pikeperch fillets and price trends of red meat fish). The price advance of red meat fish is expected to slow down in the near future due to the recovery of fish farms in South America. Estonians consume a lot less fish than inhabitants of neighbouring countries (in Finland and Sweden the consumption of fish is up to 30 kg per capita per year, while in Norway and Iceland the corresponding figure is as much as 50 kg per year). According to official data, Lithuanians and Russians also consume more fish than Estonians.
- Consumption is significantly restricted by poor availability of fresh fish (fish is not sold in stores in rural regions or in smaller stores).

People's assessment of their consumption of fish

- The EIER conducted a nationwide survey in which 1127 people assessed their consumption of fish. The survey showed that fish is eaten in smaller quantities and less often than in the past. Although typically an adult eats fish and/or fishery products once a week, the frequency of fish consumption has decreased over the past eight years. In 2011, 48% of the population ate fish and fishery products at least once a week, 27% of the population ate fish and fishery products a few times a month, and the rest ate fish and fishery products rarely or not at all.
- 38% of respondents stated that their pets also ate fish (mostly in rural regions). Families' expenditure on fish is divided as follows: 92% for people

and 8% for pets. Fresh fish and food made of fresh fish are enjoyed the most. However, fresh fish is eaten much less often than in 2003. Of fresh fish, people prefer herring and sprat, which are consumed by 84% of the population. More expensive fresh fish is consumed by 81% of the population and medium-priced fish is consumed by 77% of the population. The consumption of fish and fishery products is decli. Compared to five years ago, consumption has either decreased or remained stable as regards both fresh and frozen fish, fillets and gutted fish, and processed and unprocessed fish. Consumption has declined primarily because of the high price of fish, which is the main barrier to increased consumption or maintai the current level of consumption. Stores are the main shopping places irrespective of the species or degree of processing of fish. The quantities of frozen fish, fish fillets, smoked, salted and spiced fish (including fish preserves and other processed fish products) purchased from stores are relatively higher compared to other types of fishery products. All fresh fish are bought mainly from stores and the more expensive the fish, the more so. A considerable proportion of cheaper fresh fish and smoked fish is bought at markets. However, the quantities of smoked fish bought at markets have significantly declined. If incomes were higher, people would typically stick to or increase the usual quantity of fish bought. In this case, they would buy more expensive fish (salmon and trout), in fresh, smoked and salted form, caviar and roe, as well as medium-priced fresh fish and fish fillets. Consumers would prefer fresh fish to frozen herring and sprats. Salted Atlantic herring, salted and spiced sprats, fresh herring, sprats and other cheaper fish, fish preserves, crab sticks and noodles, fish fingers and burgers, cheaper and medium-priced smoked fish and frozen fish would be bought in the same quantities. As for these products, a sharp increase in consumed quantities or a large number of new consumers is not expected to be seen even if incomes rise.

- Freshness, taste and price are the most important factors considered when buying fish. These factors have become much more important since 2003. The trademark and packaging influence the purchase decision the least. Small amounts or an absence of additives, the species of the fish and the fact that the fish is gutted and cleaned are considered more important than the country of origin. People prefer buying cheaper fresh and chilled fish in ungutted form and medium-priced fish mostly in gutted form. Shopping preferences have shifted towards the purchase of gutted and filleted fish over the last eight years. More expensive fish are bought mostly gutted. Frozen fish are mostly bought in gutted and filleted form. Stores' assortment of fishery products was regarded as good in six product groups: salted Atlantic herring, fish preserves, fish fingers and burgers, crab sticks and noodles and fish culinary products. The assortment of the rest of fish and fishery products was regarded as satisfactory. The assortment of no products was regarded as poor in stores, but respondents were more dissatisfied with the assortment of cheaper fish (fresh, frozen and fillets). Compared to 2003, people's satisfaction with the assortment of salted fish has improved, but dissatisfaction with the assortment of cheaper fresh fish has increased. The quality of fish and fishery products bought is regarded as good or satisfactory. More expensive fresh fish, fish fillets of a higher price class, more expensive smoked fish, salted and spiced sprats, salted Atlantic herring, salted salmon and trout, fish preserves and crab sticks and noodles are deemed to be of good quality. The quality of the remai products is typically regarded as satisfactory. However, 30% of respondents mentioned having had unpleasant experiences when buying or eating fish and fishery products during the year. Quality problems prevailed: the fish purchased were old, rotten, crushed, had a bad odour or taste, were too soft, frozen several times, contained too much water (frozen fish) and so on. The favourite fish of Estonia's population are salmon, trout and herring – not Atlantic herring, sprats and salmon as in 2003. Consumer preferences have changed significantly in recent years thanks to the regular salmon and trout discount offers and campaigns in large food stores (such as Rimi, Prisma, Selver and Maxima).

- As for products, Estonian consumers love Atlantic herring products the most – whether in the form of fillets or fillet pieces, in marinade, oil or various sauces, in rolls, smoked or salted.
- Vici (the Lithuanian Viciunai Group), Viru Rand (Viru Rand OÜ) and Esva (AS Paljassaare Kalatööstus) were mentioned as the producers of favourite products the most frequently. Fresh fish would have far more consumers than they currently have if the prices were more affordable and if the availability of fish was better, i.e. if the points of sale were closer by.

Table 40. Aid granted and disbursed under the various measures of the EFF from 2008–2010 in euros

Measure	2008		2009		2010	
	Granted	Disbursed	Granted	Disbursed	Granted	Disbursed
1.1			7 853 384.00	5 284 043.42		
1.3			1 504 816.00	812 421.26	477 516.00	358 370.00
1.4			297 962.00	174 928.53	438 582.00	280 837.70
1.5			340 000.00	330 000.00	180 000.00	180 000.00
2.1			6 800 090.00	2 343 174.18		
2.2					126 518.00	62 363.89
2.3			9 384 123.00	5 763 143.89	5 498 445.00	1 751 030.58
3.1.1			2 715 010.00	2 715 010.36	5 913 062.00	4 725 231.13
3.1.2					4 005 217.00	215 438.50
3.2					485 026.00	
3.4	351 514.00	345 545.00	543 249.00	528 620.19	604 566.00	495 741.07
3.5					213 465.00	
4.1	1 824 592.00	1 181 564.92				
4.1.1					2 566 553.00	1 132 205.14
Total	**2 176 106.00**	**1 527 109.92**	**29 438 634.00**	**17 951 341.83**	**20 508 950.00**	**9 201 218.01**

Source: MoA

Aid

The European Fisheries Fund (EFF) was established by the European Commission with a view to developing and supporting sustainable fishery and financing the fisheries sector and coastal settlements so as to help them adapt to changes in the sector and to become economically resilient and ecologically sustainable. The European Union is (co-)financing fisheries aid in the period 2007–2013 with a total of 112.8 million euros. To be able to use the funds of the EFF, the Ministry of Agriculture has prepared the Estonian Fisheries Strategy 2007–2013 (approved by the Government of the Republic of Estonia) and the Operational Programme of the European Fisheries Fund 2007–2013 (approved by the European Commission) (MoA, 2011).

14 measures are being implemented under the Estonian Operational Programme of the EFF:

Measure 1.1 – Public aid for permanent cessation of fishing activities;
Measure 1.3 – Investments on board fishing vessels and selectivity;
Measure 1.4 – Small-scale coastal fishing;
Measure 1.5 – Socio-economic measures;
Measure 2.1 – Investment support for aquaculture;
Measure 2.2 – Support for inland fisheries;
Measure 2.3 – Investments in processing and marketing;
Measure 3.1.1 – Collective actions, action "Collective investments";
Measure 3.1.2 – Collective actions, action "Other collective actions";
Measure 3.2 – Protection and development of aquatic fauna and flora;
Measure 3.4 – Development of new markets and promotional campaigns;
Measure 3.5 – Pilot projects;
Measure 4.1.1 – Sustainable development of fisheries areas; and
Measure 5.1 – Technical assistance.

The measures are divided between five priority axes:

Axis I – Adaptation of the Community fishing fleet;
Axis II – Aquaculture, inland fishing, processing and marketing of fishery and aquaculture products;
Axis III – Measures of common interest;
Axis IV – Sustainable development of fisheries areas; and
Axis V – Technical assistance.

Aid has been granted through the EFF measures in Estonia since 2008. In 2008 aid was granted to 13 projects; in 2009 to 183 projects; and in 2010 to 202 projects (Table 40).

Ichthyologic and fishery-related research projects

The following is an overview of funded ichthyologic and fishery-related projects carried out in Estonia in 2010. Some are annual, others are multi-annual and some are essentially annual follow-up projects (such as the 'Implementation of the EU fisheries data collection programme and fisheries data analysis'). The list is not exhaustive (as, for example, some other large-scale projects may contain smaller parts related to fish) but highlights major projects that are important to the Estonian fishery. The overview does not include research topics and strands that have not received any funding. The number of such topics is so high in Estonian research institutions (including, for instance, the research topics of graduate students) that an overview would turn into a separate publication.

Estonian Marine Institute at the University of Tartu

From past to future – development of the populations and ecosystems of the Baltic Sea under dynamic external forces

Funded by: Ministry of Education and Research

This multiannual target-financed research project aims to: 1) explore the behaviour of the populations and ecosystems of the Baltic Sea over an extensive time scale (from one year to one hundred years) as a response to varying external factors; 2) collect new basic data on the adaptation of the biota in the Baltic Sea for the purpose of interpreting the results of long-term studies; and 3) develop and apply new indicator-based methods in the analysis of the populations and ecosystems of the Baltic Sea in the medium- and long-term perspective both retrospectively and prognostically.

Supporting natural reproduction of pikeperch by means of artificial spaw grounds: testing various types of spaw grounds and selecting the optimal type of artificial spaw grounds and mapping spaw areas

Funded by: European Fisheries Fund through ARIB

This project aims to ascertain the most appropriate construction and coating material of artificial spaw grounds so as to support natural reproduction of pikeperch, i.e. to find out what types of spaw grounds pikeperch use most frequently and what the success of pikeperch embryo development in these spaw grounds is. By means of artificial spaw grounds, the spaw areas of pikeperch in Pärnu Bay and possibly also Lake Peipsi and Matsalu Bay will be mapped.

Improving the selectivity of Danish seine

Funded by: European Fisheries Fund through ARIB

This project aims to identify the most appropriate technical solutions to increase the selectivity of the Danish seine in Estonian fishery. Improving the selectivity of demersal seines provides an opportunity to extend fishing periods, use the resources more evenly and thus keep market prices at a more stable level, as well as to reduce undesirable (or prohibited, e.g. undersized fish) by-catches.

Selectivity study of fishery and passive fishing gear

Funded by: European Fisheries Fund through ARIB

This project aims to explore the selectivity and fishing capacity of various commercial fishing methods and types of gear, to assess coastal and inland fishing selectivity as a whole on the basis of the data obtained and to make recommendations on enhancing the protection of fish stocks through the implementation of technical measures (such as abando current measures which may prove to be unreasonable as a result of the study).

Analysis of fishing capacity and recommendations on fishing efforts in the management of the fish stocks of Lakes Peipsi and Lämmijärv

Funded by: European Fisheries Fund through ARIB

This project aims to assess the fishing capacity used on the lake and, as a result, make recommendations on the ways and levels of fishing efforts to be used with the different states (size and composition) of fish stocks. The study and resulting recommendations are also necessary for the development of a long-term fishery management plan for the lake.

The state of fish spaw grounds and proposals for their improvement

Funded by: European Fisheries Fund through ARIB

Studies are being carried out which are necessary to produce a comprehensive overview of the location, current natural state and use in the territory of Estonia of the spaw grounds of selected commercial fish species, and on this basis make proposals for improvement of the spaw grounds and thus commence restoration of the migration routes and spaw grounds essential for fish. The main focus is on identifying the state of herring spaw grounds. Other important species in the case of which the state of their spaw grounds is being explored inhabit the coastal sea and rivers discharging into the sea: pikeperch and whitefish species spaw in the sea and in rivers; and Lake Peipsi whitefish, vendace, Lake Peipsi smelt and pikeperch in Lake Peipsi and the Emajõgi River.

Mitigation of negative impact of seals in Estonian fisheries using acoustic harassment devices and seal-proof netting material

Funded by: European Fisheries Fund through ARIB

The first stage of this project, which was launched in 2010 (and is to be completed in 2012), includes a detailed analysis of the negative impact of seals to determine the total amount of damage they cause, as well as damage by county and type of fishing gear. In the second stage, acoustic harassment devices will be tested to identify their effectiveness in protecting different types of fishing gear.

Implementation of the EU fisheries data collection programme and fisheries data analysis

Funded by: Environmental Investment Centre

This project involves the collection of fisheries data in accordance with Council Regulations No 199/2008 and 812/2004, Commission Regulations No 665/2008 and 1078/2008 and Commission Decision No 949/2008, analysis of the data and making recommendations for the management of fish stocks. Data collected and analyses conducted under the agreement will serve as the basis for recommendations and forecasts concer catches to be presented to the Ministry of the Environment, as well as for international cooperation on fish stocks. The agreement provides for the collection of various fisheries data (researchers' monitoring catches, sampling of commercial catches, data on the fishing industry etc.) and analysis of the data collected.

Studies of fish stocks in Lakes Peipsi, Lämmijärv and Pskov, 2010

Funded by: Environmental Investment Centre

This long-term follow-up project aims to assess the stocks of commercial fish in Lakes Peipsi, Lämmijärv and Pskov (in cooperation with Russian researchers) and prepare recommendations concer catches, as well as to collect other necessary fishery data and submit the data to the Estonian-Russian Intergovernmental Fisheries Commission for the development of fishery quotas and regulations.

Implementation of Natura 2000 in Estonian marine areas – site selection and conservation measures – ESTMAR

Funded by: Norwegian Financial Mechanism and the Environmental Investment Centre

This project (to be completed in 2011) led by the Estonian Marine Institute at the University of Tartu aims to conduct a detailed study of the biota (fish, zoobenthos, benthic flora and birdlife) in the open sea shoals of Estonian coastal waters. The part dedicated to fish will contain a quantitative overview of 12 areas: lists of species, abundance, year-round dynamics etc.

HEALFISH – Healthy fish stocks – indicators of successful river basin management

Funded by: INTERREG Programme

In 2010 work began (and will continue until 2013) with the aim of exchanging experiences with a Finnish partner regarding egress and spaw grounds of fish and developing optimal solutions to restore the population of sea trout in model rivers. The impact of beaver dams on the migration and reproductive success of sea trout will be examined in more detail, and measures necessary to restore the abundance of sea trout in the Pirita basin will be developed. The Aquaculture Department of the Institute of Veterinary Medicine and Animal Sciences at the Estonian University of Life Sciences is one of the partners in this project (fish genetics).

Centre for Limnology of the Institute of Agricultural and Environmental Sciences at the Estonian University of Life Sciences

State in 2010 and forecast of fish stocks in Lake Võrtsjärv

Funded by: Environmental Investment Centre

This project aims to examine the stock status of essential commercial fish – eel, pikeperch, pike, bream and perch. On this basis, recommendations for the management of the stocks in 2011 will be made and a recruitment-based medium-term forecast for up to five years will be issued. Test trawling results will enable the abundance of major non-commercial fish in Lake Võrtsjärv to be assessed as well.

Study on Estonian small lake fisheries 2010

Funded by: Environmental Investment Centre

This long-term follow-up project aims to take stock of fish in the small lakes of Estonia which are essential in terms of recreational fishing. Each year, 10–12 lakes are studied within the scope of the project; important lakes are studied at least once every five years. The project also analyses problems related to the introduction of potential new fishing gear (such as dragnets and traps).

Assessment of eel stocks and migration; improvement of stock assessment methodology in inland water bodies

Funded by: European Fisheries Fund through ARIB

This project aims to assess the natural migration of eel to inland water bodies and the egress of eel from water bodies into which they have been introduced, as well as to improve the data collection methodology for both lake and migration phases in order to determine the actual number of escaped eels by basin and assess the stocks of the fish. The project also aims to ascertain the stocks of eel-farming lakes using the marking-recapture method; evaluate the migration of eels throughout the fishing period; and test different trap net types for sustainable fishery.

Modernisation of the equipment and tools needed to assess stocks of commercial fish and improvement of stock assessment methodology at the Estonian University of Life Sciences

Funded by: European Fisheries Fund through ARIB

This multiannual project started in 2010 and aims to modernise the material resources necessary for fieldwork and laboratory work (equipment, tools, research and analytical methods) at the Centre for Limnology of the Estonian University of Life Sciences to ensure the international competitiveness of research and the reliability of results. Among other things, it is intended to acquire a modern trawler which will enable the data collection that started on Lake Võrtsjärv in 1978 to be continued with current methodology, which in turn is a prerequisite for maintai and continuing long data series.

Impact of anthropogenic hazardous substances on the health of the Baltic Sea ecosystem – BEAST (Biological Effects of Anthropogenic Stress: Tools for Assessment of Ecosystem Health)

Funded by: BONUS+

Within the scope of this project, being carried out from 2009–2011, marine biologists from Baltic Sea countries have examined the effects of toxic pollutants on both aquatic invertebrates and fish consumed by humans. The Estonian working group comprised researchers from the Estonian University of Life Sciences and the University of Tartu. In the course of their work the impact of organic pollution (such as petroleum products) on the eelpout and flounder in Estonian coastal waters was studied.

Aquaculture Department of the Institute of Veterinary Medicine and Animal Sciences at the Estonian University of Life Sciences

Genetic diversity and sustainable management of genetic resources of farm animals and fish

Funded by: Ministry of Education and Research

This multiannual target-financed research project aims to identify the genetic characteristics of the species and populations of fish farmed in Estonia and to analyse factors affecting the fish and variability of these factors.

Genetic impact of stocking activities on neutral and adaptive variation in endangered salmonid fish and noble crayfish (Astacus astacus) populations

Funded by: Estonian Science Foundation

This project deals with the impact of introducing farmed fish in natural water bodies on the gene pool of endangered species living in the wild.

Linking genotype with phenotype in a variable and changing natural environment – genetic analyses of host-parasite systems in salmonid fish

Funded by: Estonian Science Foundation

This project studies the genes that cause the spread of proliferative kidney disease (PKD) and resistance to the disease.

HEALFISH – Healthy fish stocks – indicators of successful river basin management

Funded by: INTERREG

This project, which started in 2010 (and will run until 2013), aims to study the genetic structure of the populations of sea trout in Estonia compared to sea trout in other countries around the Gulf of Finland. The Estonian Marine Institute at the University of Tartu is one of the partners in the project (studying fish migration, migration barriers and reproduction opportunities).

Wildlife Estonia

Overview and monitoring of habitats and species and preparation of a draft management plan for six special conservation areas

Funded by: Environmental Board

This project studies the fish stocks of five rivers in Ida-Viru County which form part of the Natura 2000 network – Narva River, Tagajõgi River, Pühajõgi River, Padajõgi River and Avijõgi River – with a particular focus on conservation aspects. The project also involves extensive studies of the migration of the Narva River lamprey in the lower reaches of the river, using the marking-recapture method and telemetry. The distribution of Amur sleeper (Perccottus glenii) in the Narva River system is being examined as well.

Saving life in meanders and oxbow lakes of the Emajõgi River in Alam-Pedja NATURA 2000 area

Funded by: EU LIFE+ Programme, Environmental Investment Centre

This project aims to thoroughly study the fish fauna in 21 meanders and oxbow lakes in the upper reaches of the Suur-Emajõgi River. In addition, it aims to observe the dynamics of the species composition and abundance of fish and the dependence of the dynamics on changes in oxygen content before and after dredging the mouths of the meanders, as well as to study the migration of marked fish (especially bream).

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