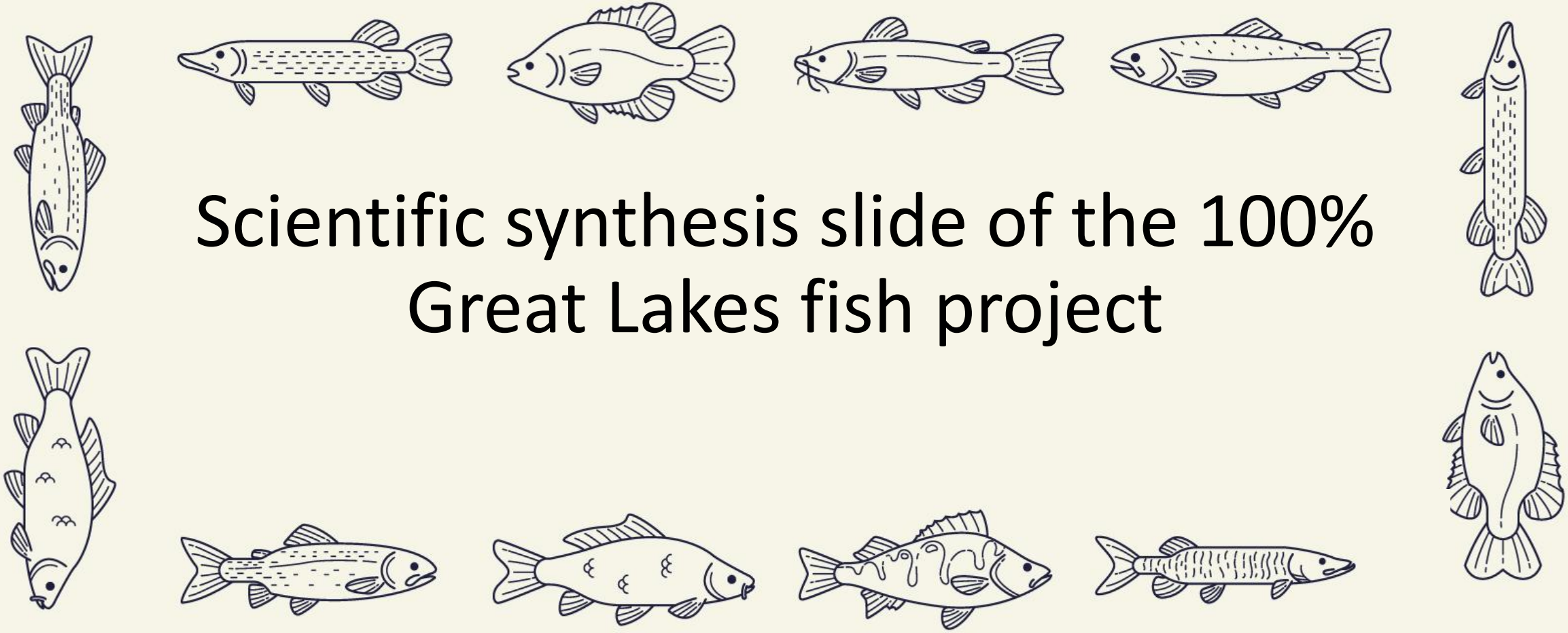

Scientific synthesis slide of the 100% Great Lakes fish project

Great Lakes St. Lawrence Governors & Premiers

2025-04-18

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merinov

Context, assumption, and disclaimer

- Context:
  - 17 slides were prepared to summarize the various reports relating to the 100 % Great Lakes fish project .Some of these slides have companion slide to help in their understanding. The raw or intermediate data and figure can be provided on demand.

- Disclaimer:
  - The dataset in the source reports is surprisingly sparse; significant effort was made to fill in the missing values. This is especially true for composition data and mass breakdown by anatomic parts. It is important to present this dataset as an estimation and not as the result of a strict scientific survey. Details of the estimation method for each value presented here can be provided on demand.
  - In the future, it would be advisable to do a thorough screening of the composition of the different commercially important fish species of the great lake to get much more accurate data on which to base business decision.

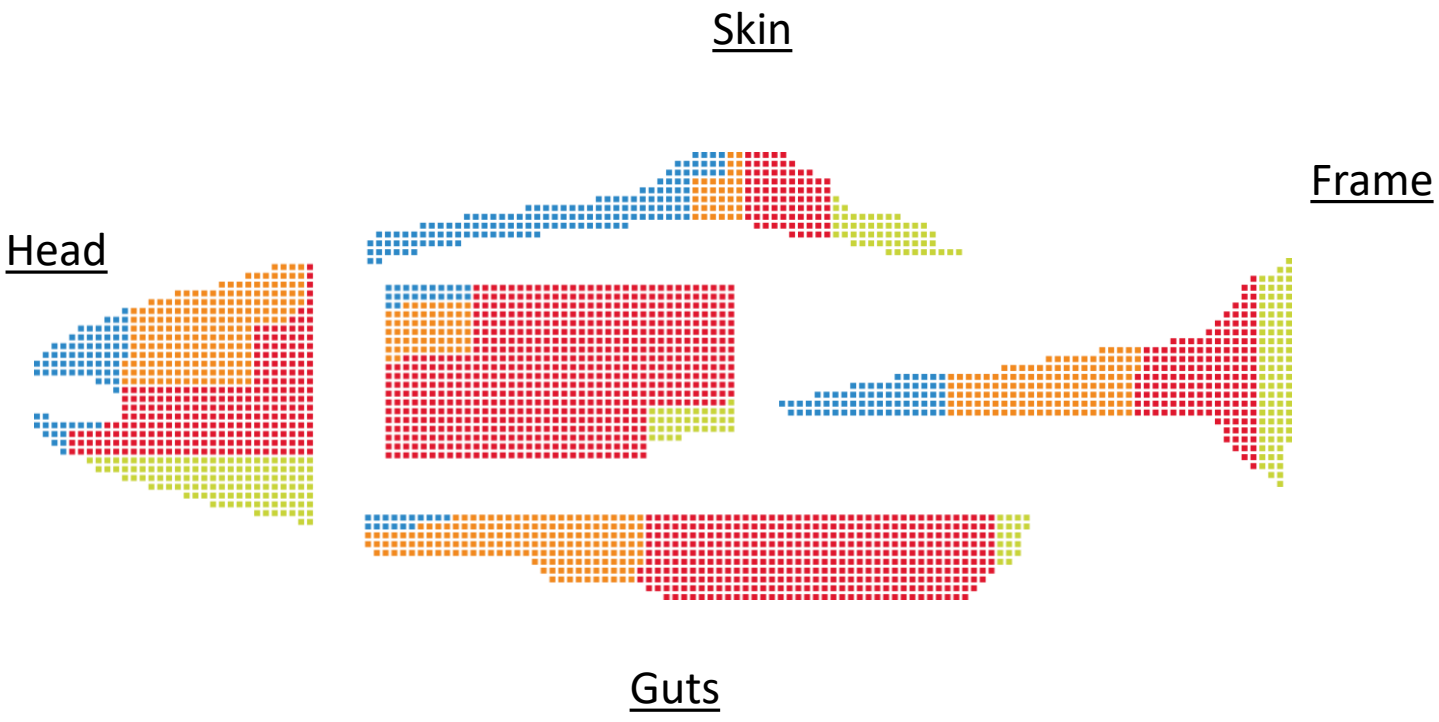
Assumption

- A) All fish have the same composition regardless of catch time
- B) All fish compositions are the same from one fishing location to another
- C) Fish are built of 5 main components: collagen, fat, protein (other than protein),mineral, and water
- D) gelatin=collagen=glue, they only represent different levels of hydrolysis
- F) Male and female fish have the same composition and property (Roe=Milt)
- G)**For evaluation of landings, 2024 data was used from the GSPP 100% Great Lakes Fish map consulted on April 2025**
- H) Some prices were pulled from online sources to supplement the analysis. Some price included in the reports led to unrealistic estimates. Otherwise, data presented here is strictly from the provided reports.
- I) Unless specified all data represent yearly availability of mass.
- J)The imperial short tons (2000 lb) is used everywhere unless specified. Same thing goes for USD.

Slide 0: Anatomical nomenclature

- Fillet: includes belly flap and excludes skin. 
- Scale: scale without skin, analogue to epidermis in human. 
- Dermis: dermis without scale, analogue to dermis in human 
- Head: contains gills, head meat, head skin, head bone and body fins. 
- Frame: includes frame bone, body fins, and meat. 
- Liver: hard fatty organ. 
- Roe: include soft roe(milt) and regular roe. 
- Viscera: digestive system without hard organs (liver, roe, heart, etc.). 
- Guts: content of the belly, includes roe, viscera, liver and swim bladder
- skin: includes dermis and scales.

Slide 1: Biomass harvested yearly



Dry component	Biomass (ton/year)
Collagen	330
Oil	602
Protein	1550
Mineral	325

Slide 1A: Companion slide, mass per part

All Species	all biomass				
	Collagen	Oil	Protein	Mineral	Water
Product	lb/year	lb/year	lb/year	lb/year	lb/year
Head	151700	383719	510295	255918	2353742
Rack	138165	274727	322081	181777	1374552
Fillet	44863	119876	1314072	69935	5097572
Skin	290698	71069	165987	105954	1021584
Guts	31064	354131	790937	37117	3388811
Total	656490	1203522	3103372	650701	13236261

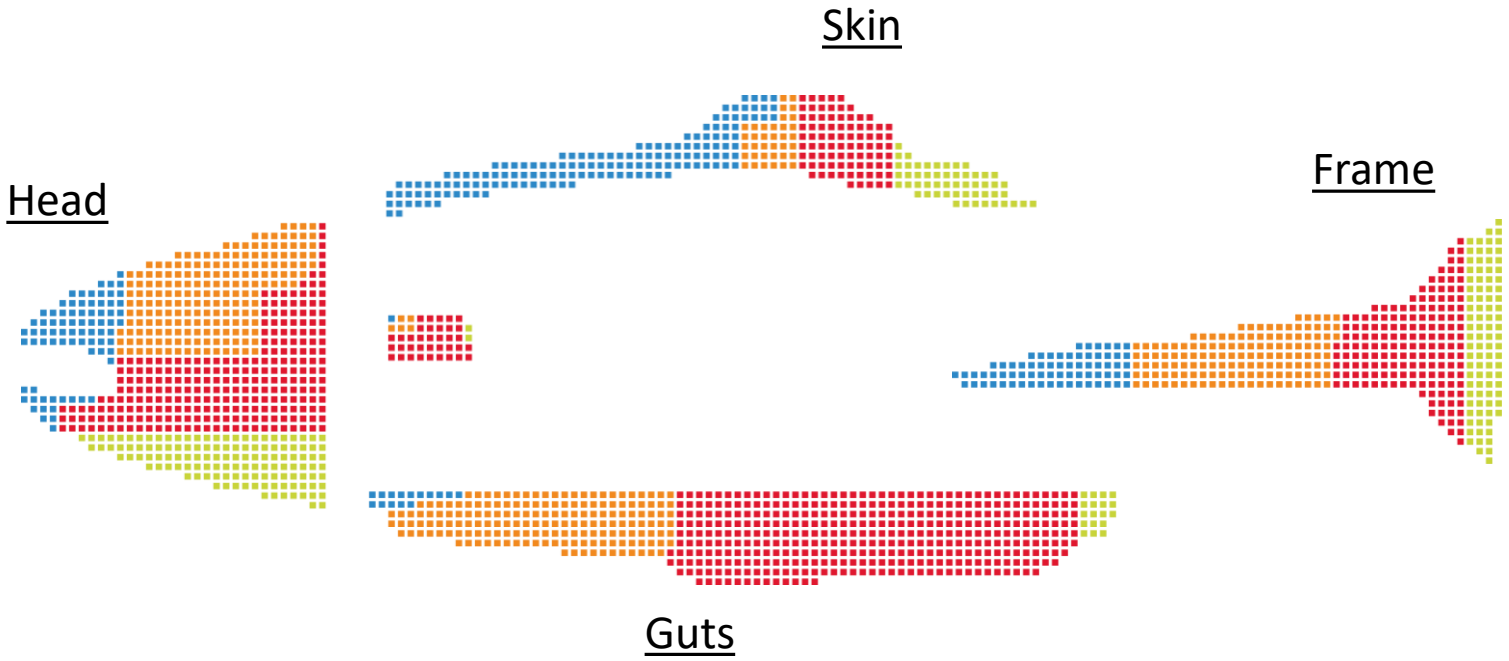
Caveats:

Adds up to 18.9M pound of biomass

According to data to the survey from 100% Great Lakes Fish project dashboard for these 6 species, there should be 20.5 M fish harvested

This discrepancy can be explained by the water loss during thawing of fish prior to scientific dissection done by the partners and the loss on blood and mucus during the dissection.

Slide 2: Byproduct available by year



Dry component	Byproduct (ton/year)
Collagen	309
Oil	543
Protein	920
Mineral	292

Collagen Oil Protein Mineral = 1 ton/year

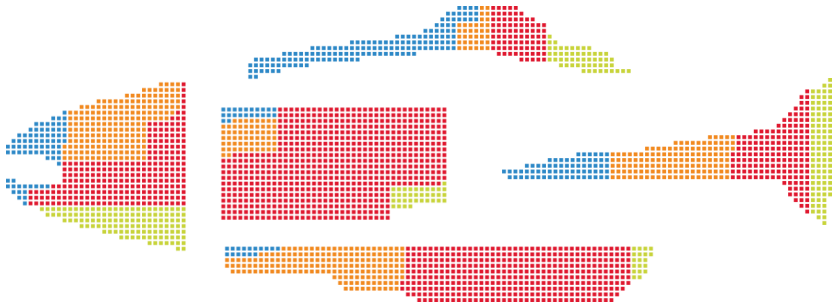
Slide 2A: Companion slide, mass per parts

Species	Percent utilization		
	Fillet (skinless)	Roe	Other parts
Walleye	100%	0%	0%
Yellow perch	100%	0%	0%
Whitefish	100%	0%	0%
Cisco	0%	50%	0%
Lake trout	100%	0%	0%
White sucker	0%	0%	0%

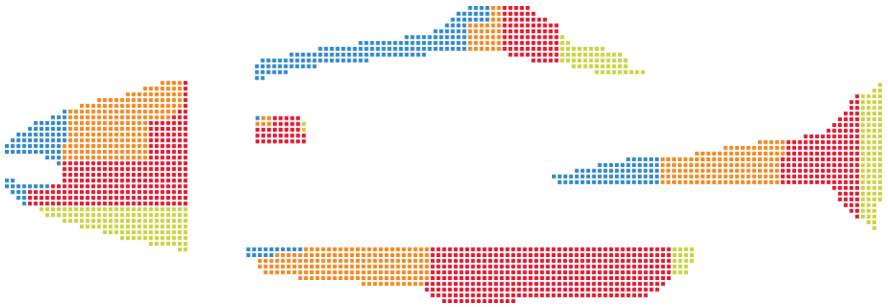
Leftover component					
	Collagen	Oil	Protein	Mineral	Water
Product	lb/year	lb/year	lb/year	lb/year	lb/year
Head	151700	383719	510295	255918	2353742
Rack	138165	274727	322081	181777	1374552
Fillet	2220	10869	71785	3086	240963
Skin	290698	71069	165987	105954	1021584
Guts	30622	344695	774133	36868	3350216
Total	613405	1085079	1844280	583602	8341057

Slide 3: Biomass harvested and byproduct left

Raw biomass



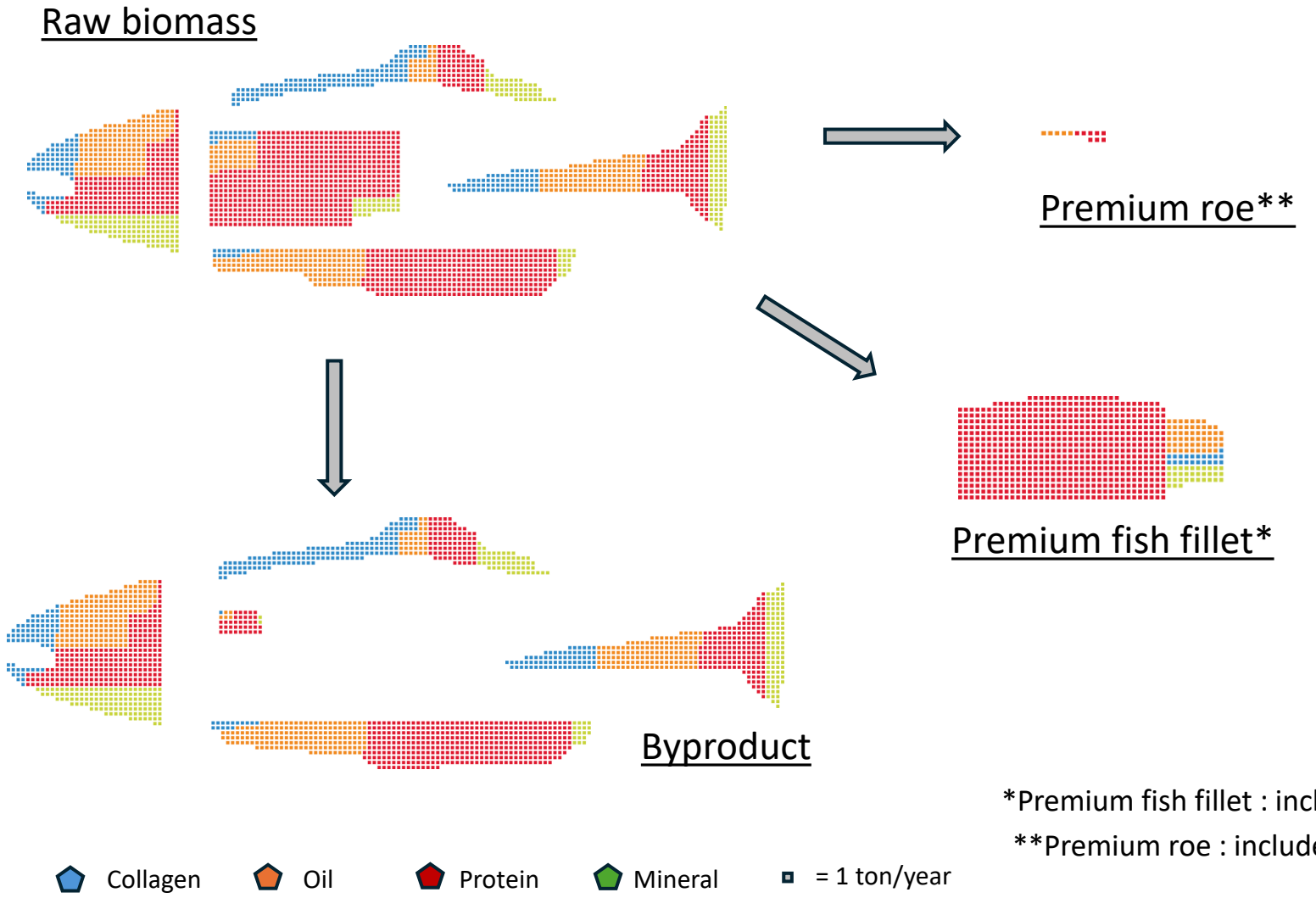
Byproduct leftover



Collagen Oil Protein Mineral = 1 ton/year

Dry component	(Ton /year)		(%)
	Biomass	Byproduct	Utilization
Collagen	330	309	7%
Oil	602	543	10%
Protein	1550	920	41%
Mineral	325	292	10%
Total	2807	2063	26%

Slide 4: Product and byproduct



Dry component	(Ton /year)		(%)
	Biomass	Byproduct	Utilization
Collagen	330	309	7%
Oil	602	543	10%
Protein	1550	920	41%
Mineral	325	292	10%
Total	2807	2063	26%

*Premium fish fillet : includes fillet of walleye, yellow perch, whitefish, and lake trout

**Premium roe : include female cisco roe only , excludes soft roe

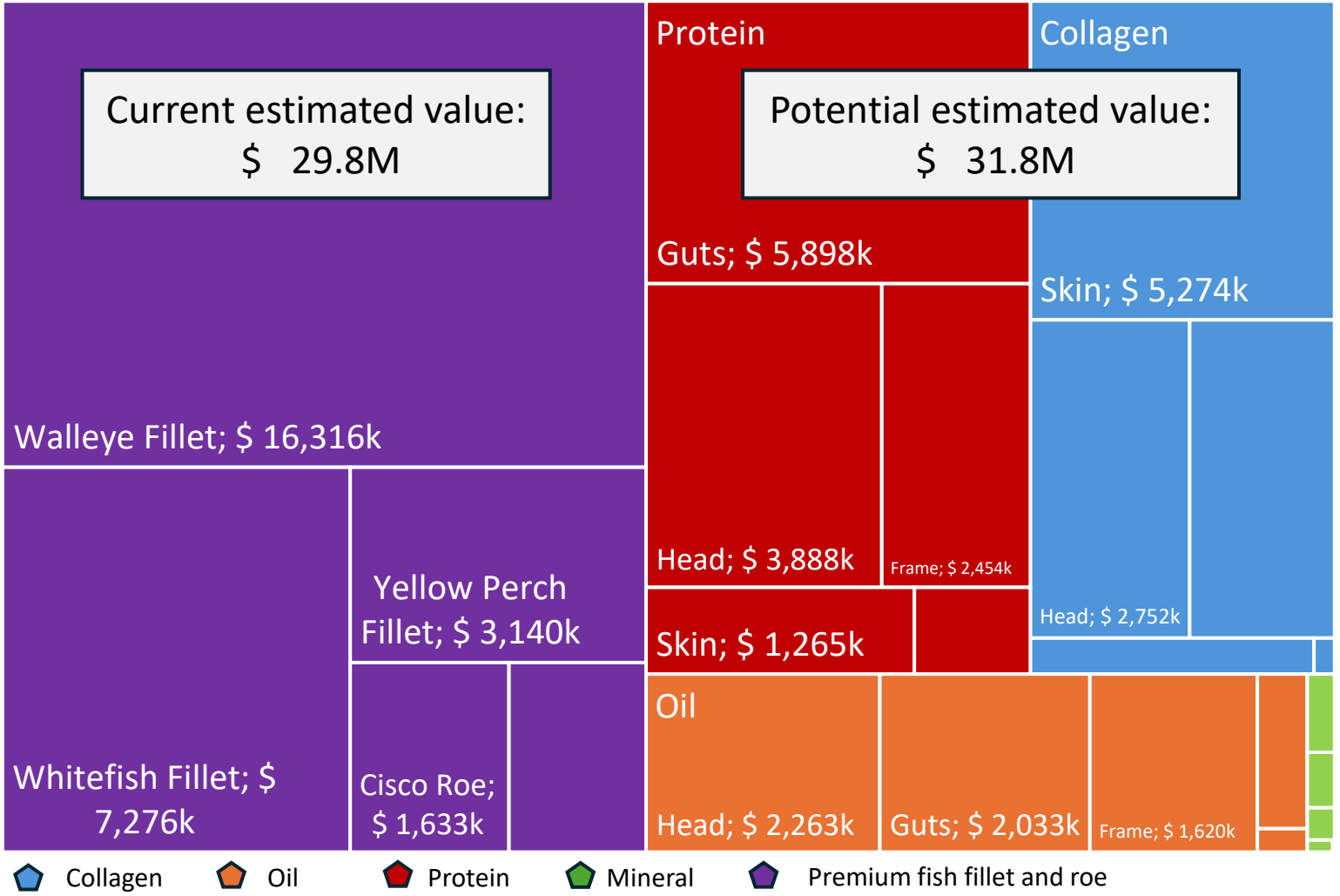
Slide 4A: Companion slide, fillet and roe sold

	walleye	yellow_perch	whitefish	Cisco	lake_trout	white_sucker
Parts	fillet	fillet	fillet	Roe (female)	fillet	fillet
Amount (lb/year)	3623400	626400	1865691	65527	201904	0
Price (USD/lb)	$ 4.50	$ 5.01	$ 3.90	$ 24.92	$ 7.00	$ -
Value (USD/year)	$ 16,315,661	$ 3,139,639	$ 7,276,195	$ 1,633,188	$ 1,413,329	$ -

Slide 5: Scenario 100% fish treemap

Product	Value* (USD/lb)
Walleye fillet	$ 4.50
Yellow perch fillet	$ 5.01
Whitefish fillet	$ 3.90
Lake trout fillet	$ 7.00
Cisco roe	$ 24.92
Collagen	$ 18.14
Oil	$ 5.90
Protein	$ 7.62
Mineral	$ 0.45

*Value at an intermediate point in the value chain (bulk consumer price) are used for all prices for the sake of comparison

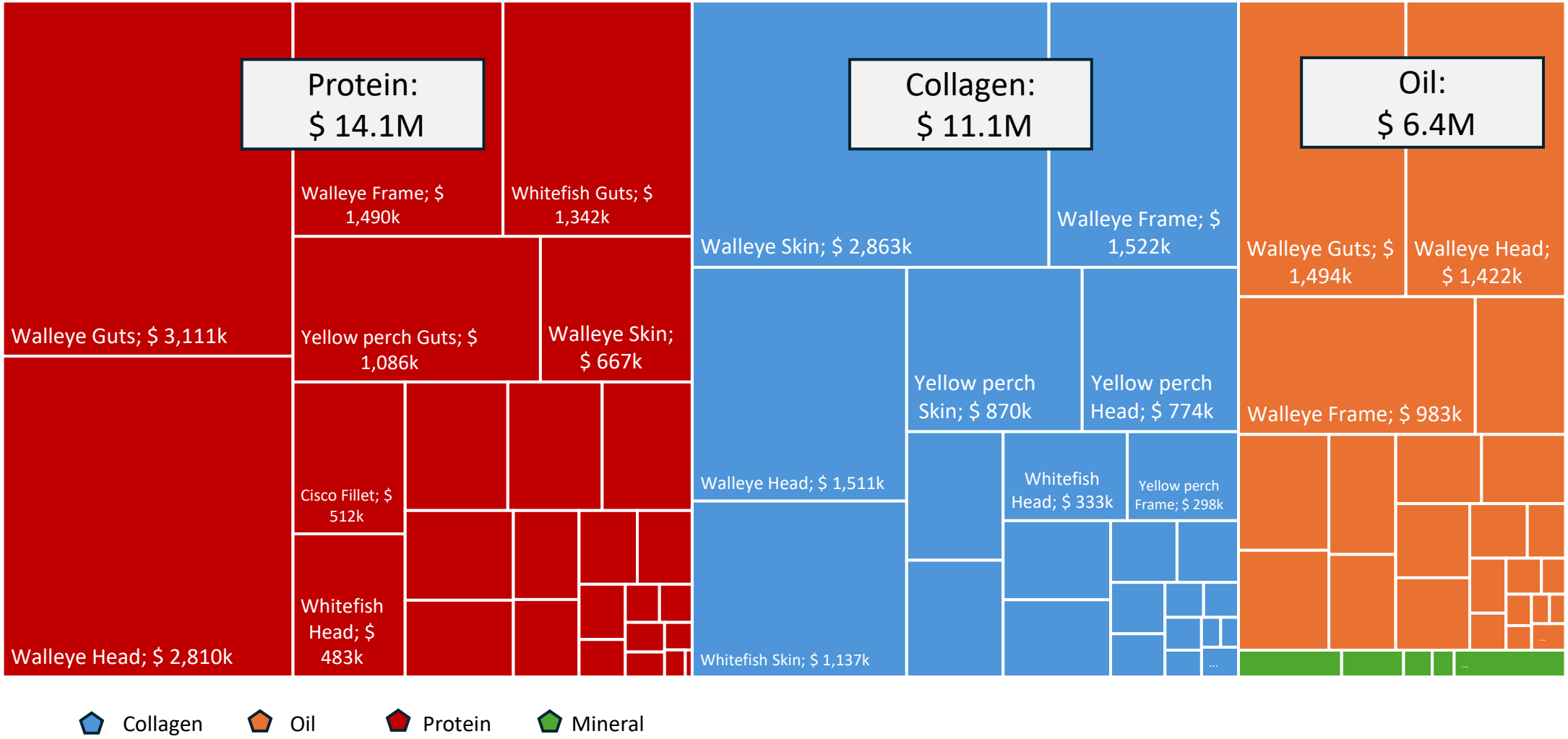


Slide 6A: Companion slide, source and caveat

	Species	Value (USD/kg)	source	Comment
Fillet	Walleye	$ 9.93	multispecies report 6.5 to 7.7$/lb 2022 for whole fish	0
Fillet	Yellow perch	$ 11.05	Figure 8 Multispecies report	large retail stores
Fillet	Whitefish	$ 8.60	Figure 25 whitefish report	0
Fillet	Lake trout	$ 15.43	Figure 9 Multispecies report	large retail stores
Roe	Cisco	$ 54.95	Order | Tidewater Herring Roe	0
Collagen	Collagen	$ 40.00	Table 6: matis cisco report	gelatine average bracket between 20 et 60 usd/kg
Oil	Oil	$ 13.00	bulknaturaloils.com/fish-oil-18-epa-12-dha	food grade oil semi retail prefered over the 4.07usd/kg in the report
Protein	Protein	$ 16.80	Canadian protein.com cheapest whey protein on sales check 2024	choose over the 1.6534 value because judged too low
Mineral	Mineral	$ 1.00	Table 5 Matis cisco report	feed grade

- Collagen and oil have a higher upsale potential (higher price ceiling) then fillet or roe
  - They can target many niche markets
  - They can be refined to reach higher-grade market (pharma, nutraceutical, etc.)
- Protein also has this potential, but to a much lesser extent
- Instead of processing the byproduct into collagen/oil/protein, it might be more profitable, for certain byproducts to forgo chemical treatment and only be mechanically treated for the food markets.
  - Example making mixed meat out of frame
  - Selling fish liver or roe as is
- Collagen from head and frame?
  - Even if there is a lot of collagen in the heads and frames, it is more complex to extract is. Extraction nis simpler from the skin and scale.

Slide 6: Scenario 100% fish treemap (detail)

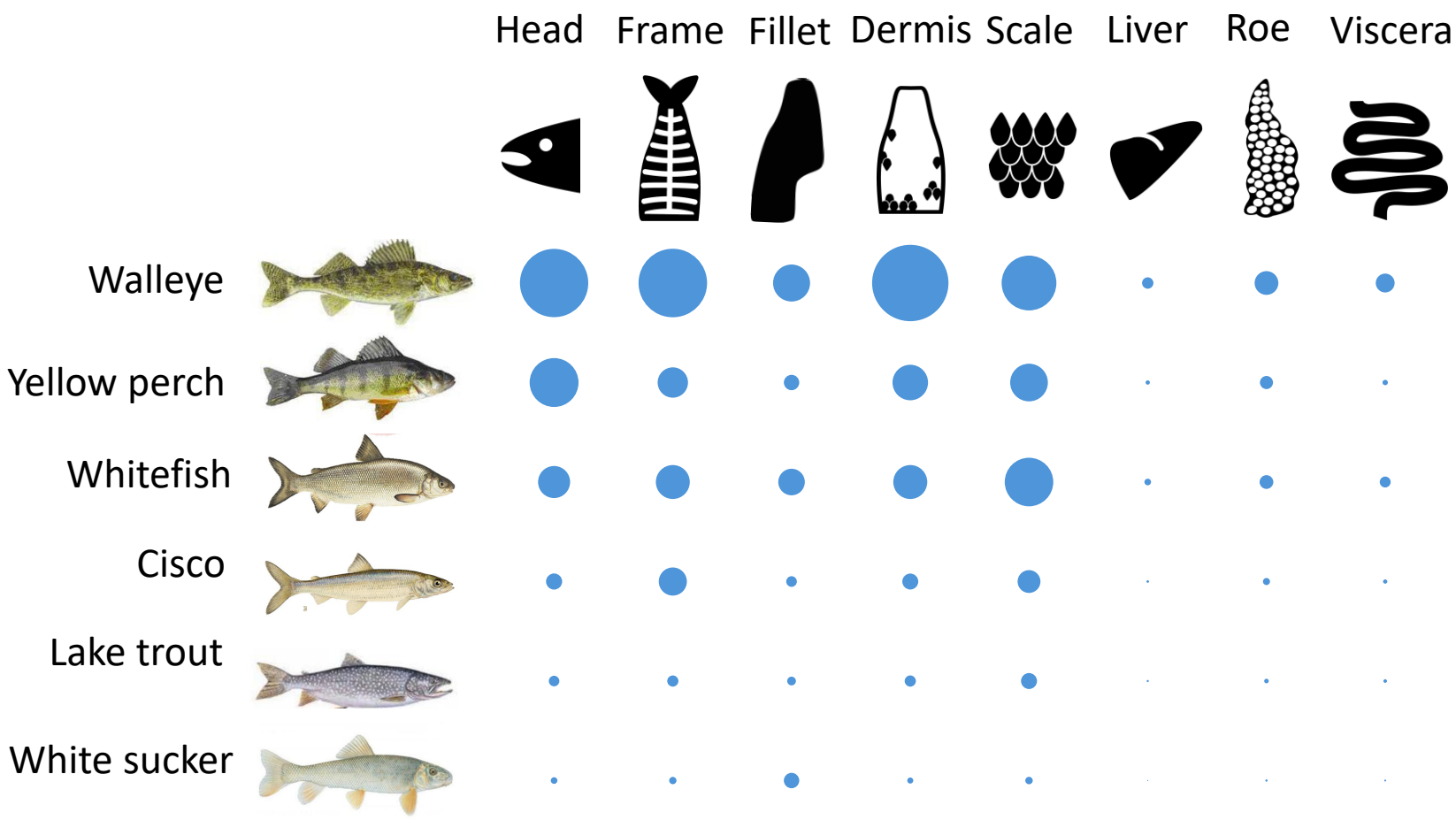


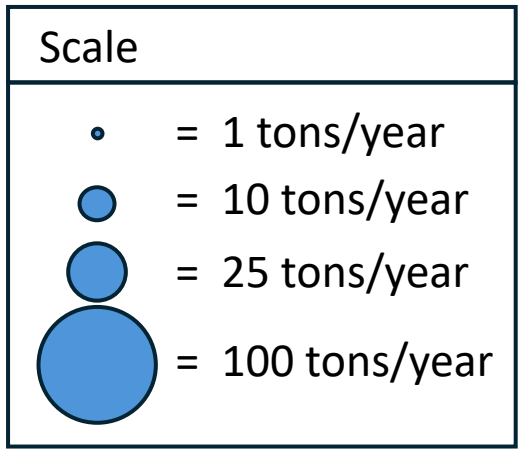
Slide 6A: Companion slide, amount breakdown

aMOUNTr	Collagen	Oil	Protein	Mineral
Source	lb/year	lb/year	lb/year	lb/year
Walleye Head	83282	241111	368801	184365
Walleye Frame	83865	166757	195500	110337
Walleye Fillet	0	0	0	0
Walleye Skin	157821	27329	87516	51321
Walleye Guts	18693	253350	408280	22763
Yellow perch Head	42655	53577	52191	38751
Yellow perch Frame	16444	32697	38333	21634
Yellow perch Fillet	0	0	0	0
Yellow perch Skin	47950	4094	16934	26676
Yellow perch Guts	3900	30251	142520	4375
Whitefish Head	18363	63460	63424	22844
Whitefish Frame	20570	40902	47952	27063
Whitefish Fillet	0	0	0	0
Whitefish Skin	62676	29679	45738	20224
Whitefish Guts	6282	46227	176124	7650
Cisco Head	4635	16019	16010	5766
Cisco Frame	14112	28060	32896	18566
Cisco Fillet	2022	10185	67204	2666
Cisco Skin	13838	6553	10098	4465
Cisco Guts	885	10648	23159	873
Lake Trout Head	1987	6868	6864	2472
Lake Trout Frame	2226	4426	5189	2929
Lake Trout Fillet	0	0	0	0
Lake Trout Skin	6783	3212	4950	2189
Lake Trout Guts	680	1852	20162	985
White sucker Head	777	2685	3005	1720
White sucker Frame	948	1885	2210	1248
White sucker Fillet	198	684	4580	420
White sucker Skin	1630	202	752	1079
White sucker Guts	181	2368	3889	223

VALUE	Collagen	Oil	Protein	Mineral
Source	USD/year	USD/year	USD/year	USD/year
Walleye Head	$ 1,511,047	$ 1,421,760	$ 2,810,042	$ 83,627
Walleye Frame	$ 1,521,625	$ 983,316	$ 1,489,593	$ 50,048
Walleye Fillet	$ -	$ -	$ -	$ -
Walleye Skin	$ 2,863,457	$ 161,152	$ 666,820	$ 23,279
Walleye Guts	$ 339,168	$ 1,493,930	$ 3,110,846	$ 10,325
Yellow perch Head	$ 773,924	$ 315,925	$ 397,667	$ 17,577
Yellow perch Frame	$ 298,351	$ 192,803	$ 292,071	$ 9,813
Yellow perch Fillet	$ -	$ -	$ -	$ -
Yellow perch Skin	$ 869,990	$ 24,141	$ 129,025	$ 12,100
Yellow perch Guts	$ 70,763	$ 178,380	$ 1,085,915	$ 1,985
Whitefish Head	$ 333,175	$ 374,206	$ 483,252	$ 10,362
Whitefish Frame	$ 373,222	$ 241,186	$ 365,366	$ 12,276
Whitefish Fillet	-$ 0	-$ 0	-$ 0	-$ 0
Whitefish Skin	$ 1,137,173	$ 175,009	$ 348,493	$ 9,174
Whitefish Guts	$ 113,983	$ 272,585	$ 1,341,961	$ 3,470
Cisco Head	$ 84,103	$ 94,460	$ 121,987	$ 2,616
Cisco Frame	$ 256,039	$ 165,459	$ 250,649	$ 8,421
Cisco Fillet	$ 36,686	$ 60,057	$ 512,058	$ 1,209
Cisco Skin	$ 251,071	$ 38,639	$ 76,942	$ 2,025
Cisco Guts	$ 16,050	$ 62,786	$ 176,454	$ 396
Lake Trout Head	$ 36,056	$ 40,496	$ 52,297	$ 1,121
Lake Trout Frame	$ 40,390	$ 26,101	$ 39,540	$ 1,328
Lake Trout Fillet	-$ 0	-$ 0	-$ 0	-$ 0
Lake Trout Skin	$ 123,064	$ 18,939	$ 37,714	$ 993
Lake Trout Guts	$ 12,335	$ 10,918	$ 153,623	$ 447
White sucker Head	$ 14,095	$ 15,831	$ 22,893	$ 780
White sucker Frame	$ 17,204	$ 11,118	$ 16,842	$ 566
White sucker Fillet	$ 3,597	$ 4,035	$ 34,900	$ 191
White sucker Skin	$ 29,582	$ 1,190	$ 5,728	$ 489
White sucker Guts	$ 3,289	$ 13,965	$ 29,628	$ 101

Slide 7 : Collagen yearly harvest

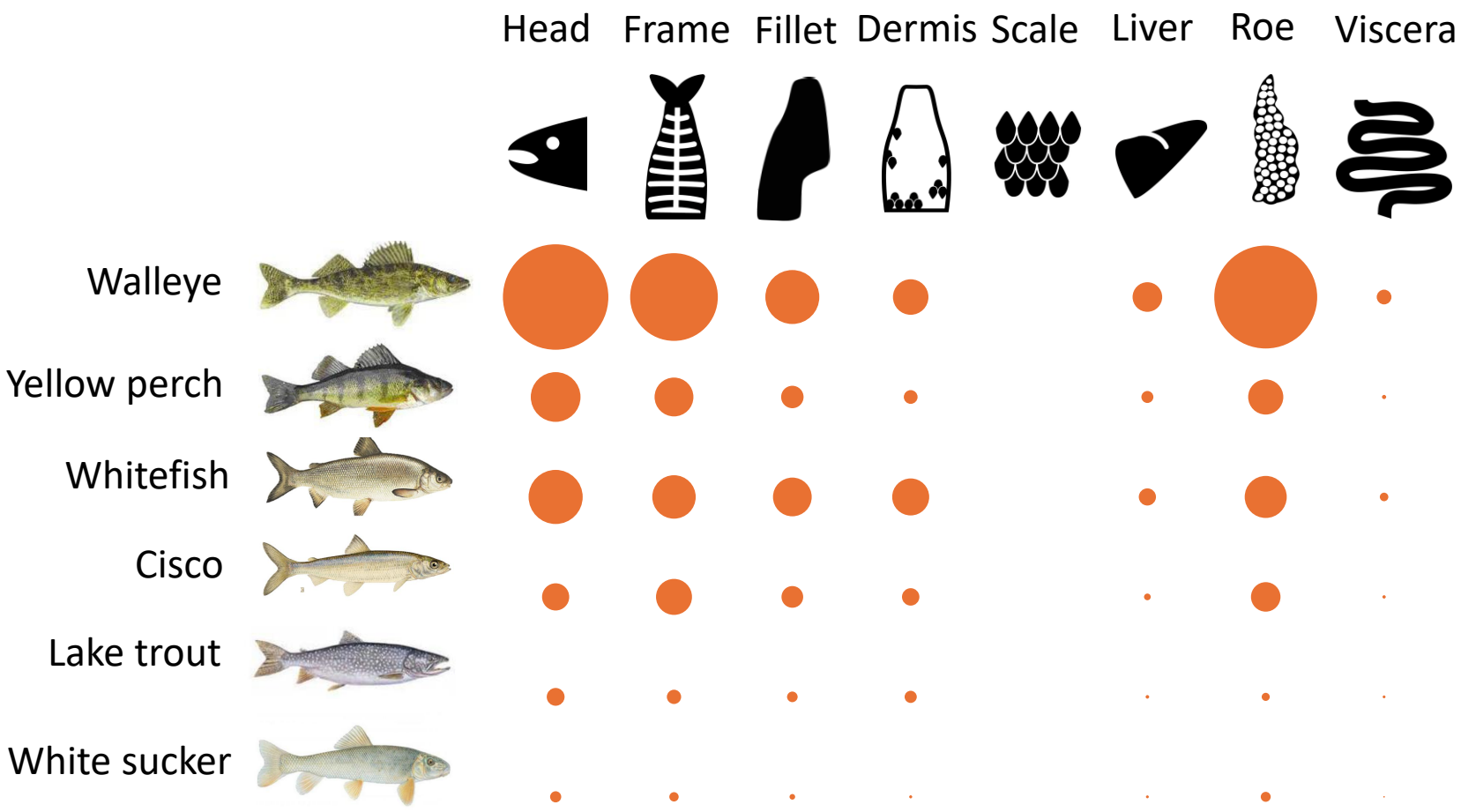


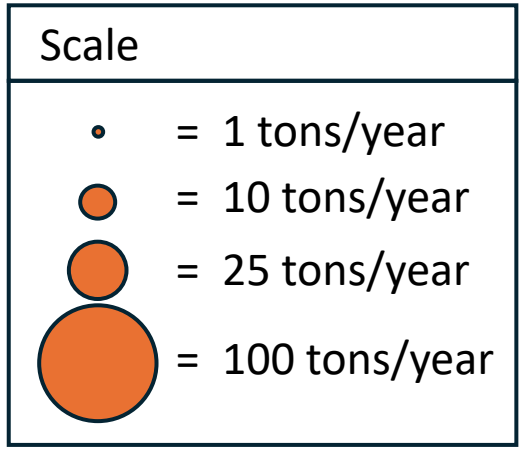


Slide 7A : Companion slide, raw value

collagen	0	0	0	0	0	0
	Walleye	Yellow perch	Whitefish	Cisco	Lake trout	White sucker
Product	lb/year	lb/year	lb/year	lb/year	lb/year	lb/year
Head	83282	42655	18363	4635	1987	777
Frame	83865	16444	20570	14112	2226	948
Fillet	24458	4228	12593	2022	1363	198
Dermis	104206	22581	20606	4549	2230	644
Scales	53615	25369	42070	9288	4553	986
Liver	2306	328	775	118	84	22
Roe	10047	3062	3376	885	365	94
Viscera	6341	510	2131	324	231	66

Slide 8 : Oil yearly harvest

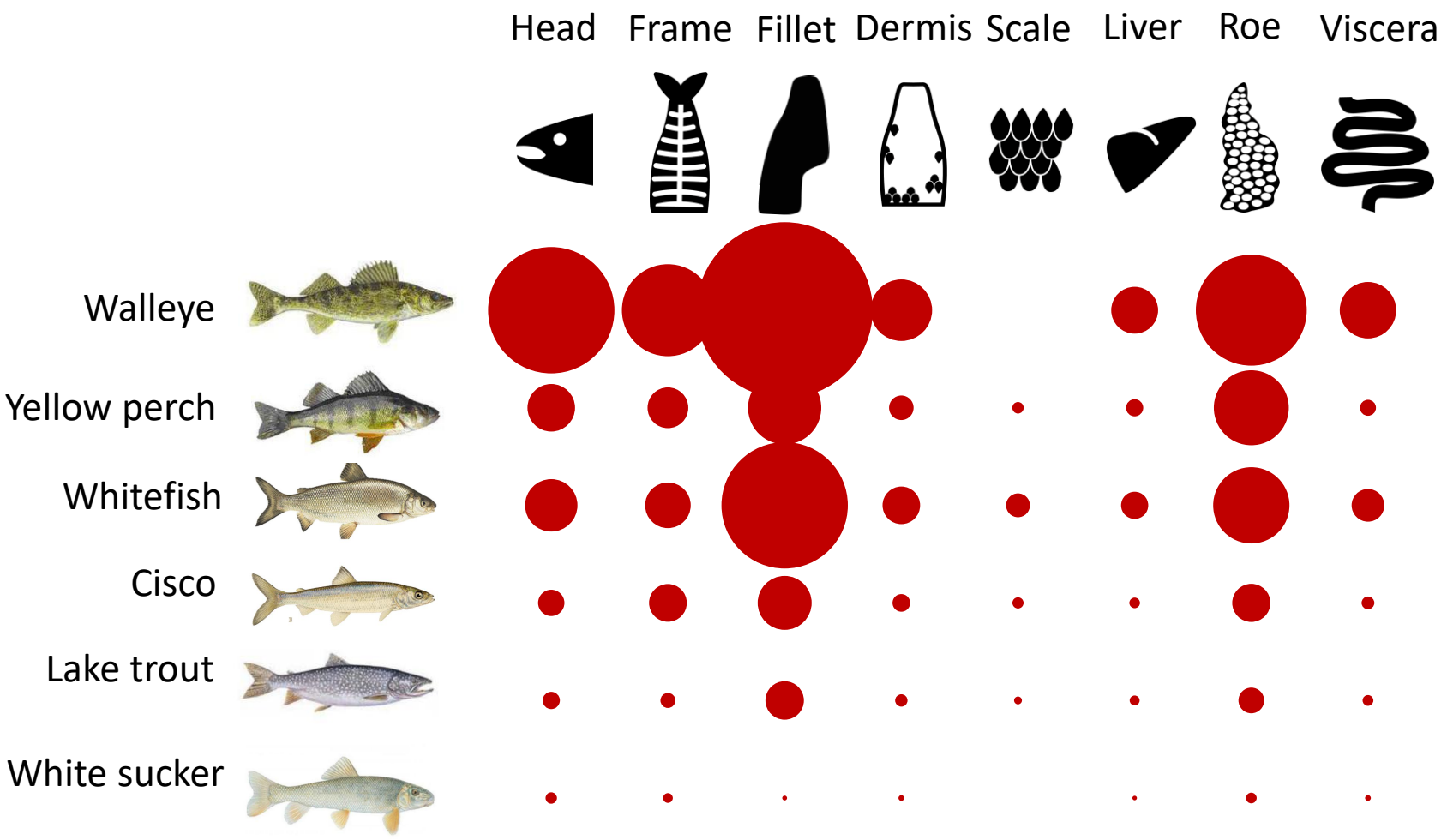


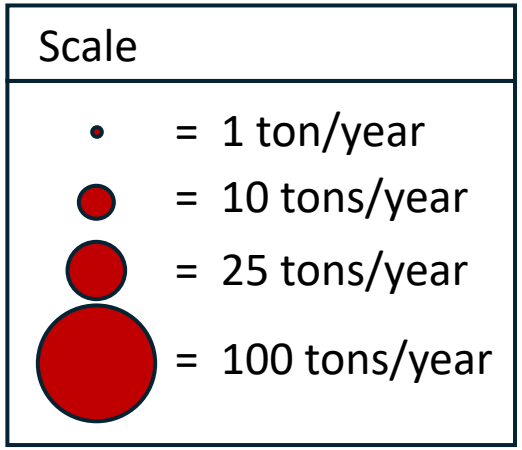


Slide 8A : Companion slide, raw value

oil	Walleye	Yellow perch	Whitefish	Cisco	Lake trout	White sucker
Product	lb/year	lb/year	lb/year	lb/year	lb/year	lb/year
Head	241111	53577	63460	16019	6868	2685
Frame	166757	32697	40902	28060	4426	1885
Fillet	63151	10917	32516	10185	2423	684
Dermis	27329	4094	29679	6553	3212	202
Scales	0	0	0	0	0	0
Liver	18993	3110	6383	972	273	177
Roe	229660	26762	38265	18872	1407	2142
Viscera	4697	378	1579	240	171	49

Slide 9 : Protein yearly harvest





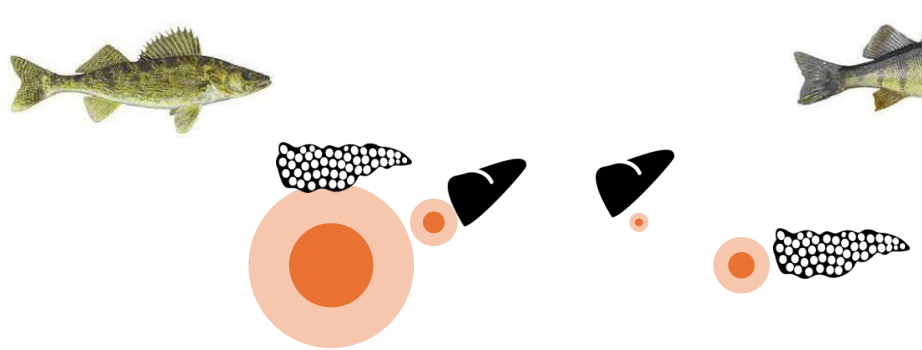
Slide 9A : Companion slide, raw value

protein	Walleye	Yellow perch	Whitefish	Cisco	Lake trout	White sucker
Product	lb/year	lb/year	lb/year	lb/year	lb/year	lb/year
Head	368801	52191	63424	16010	6864	3005
Frame	195500	38333	47952	32896	5189	2210
Fillet	715803	123745	368567	67204	34172	4580
Dermis	87516	13899	32605	7199	3528	752
Scales	0	3035	13133	2900	1421	0
Liver	50711	6806	17042	2594	2264	473
Roe	284061	129798	134379	33609	15224	2650
Viscera	73508	5916	24704	3760	2673	766

Slide 10 : Oil quality for selected species

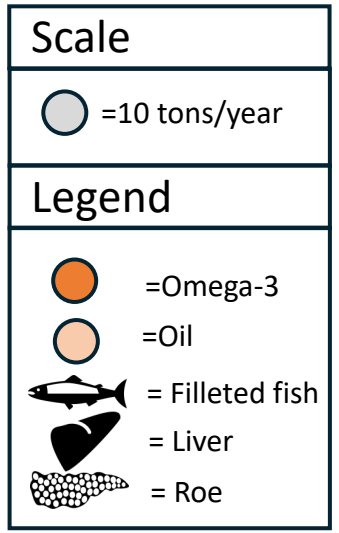
Walleye

Yellow perch



Whitefish

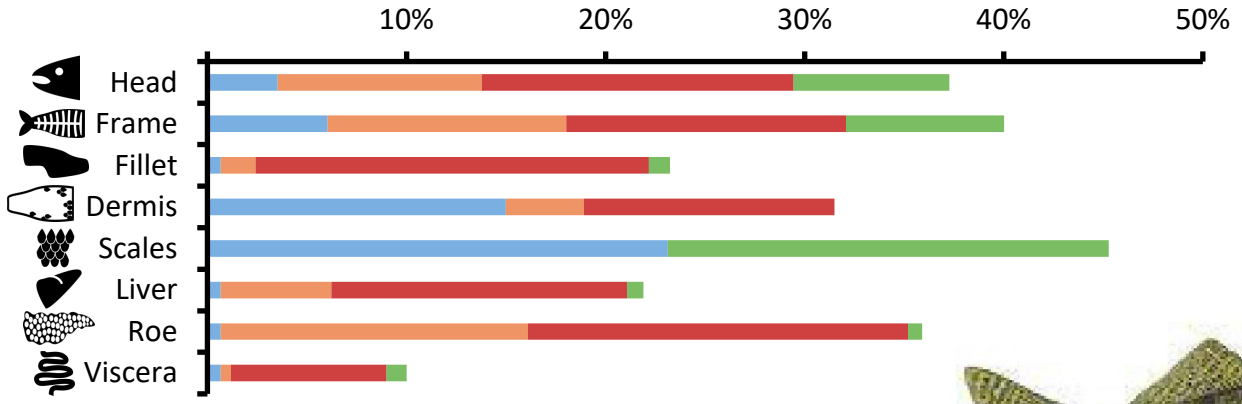
Laketrout



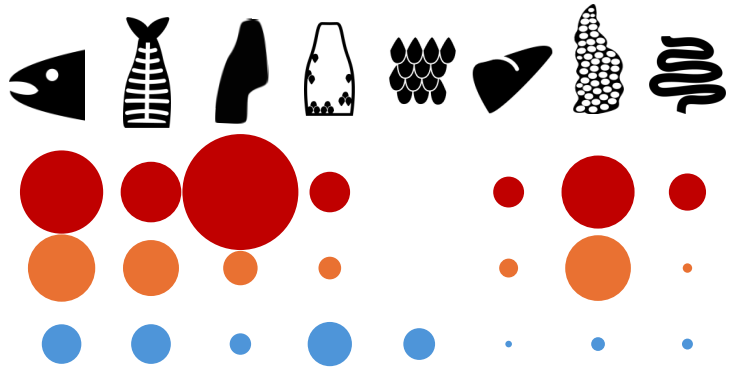
Component	(tons /year)		(%)
	Oil	Omega-3	Omega-3
Walleye liver	9	2	21%
Walleye roe	115	30	26%
Yellow perch liver	2	0.3	17%
Yellow perch roe	13	3	22%
Whitefish filleted fish	14	2	13%
Lake trout filleted fish	18	4	20%
Total	172	40	24%

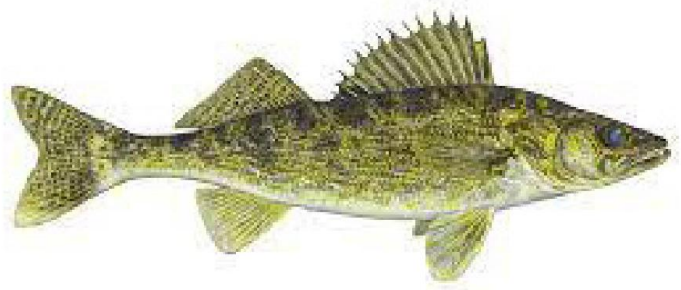
Slide 11 : Walleye slide

Anatomical composition

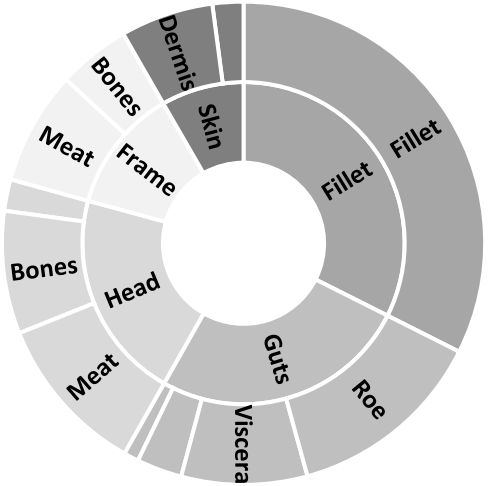


Biomass harvested yearly



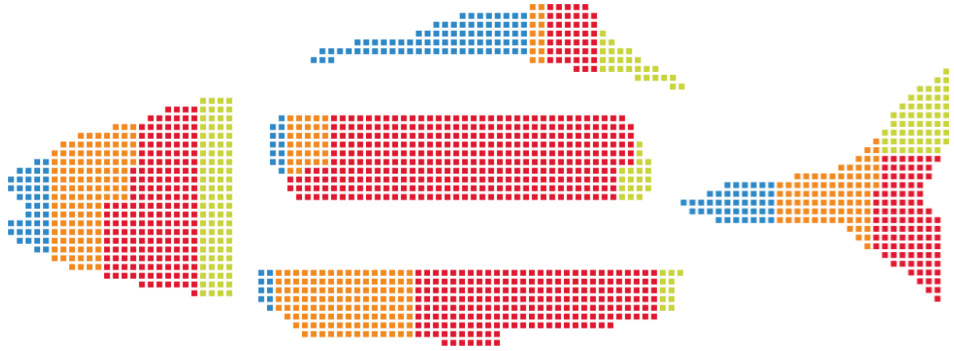


Anatomical breakdown



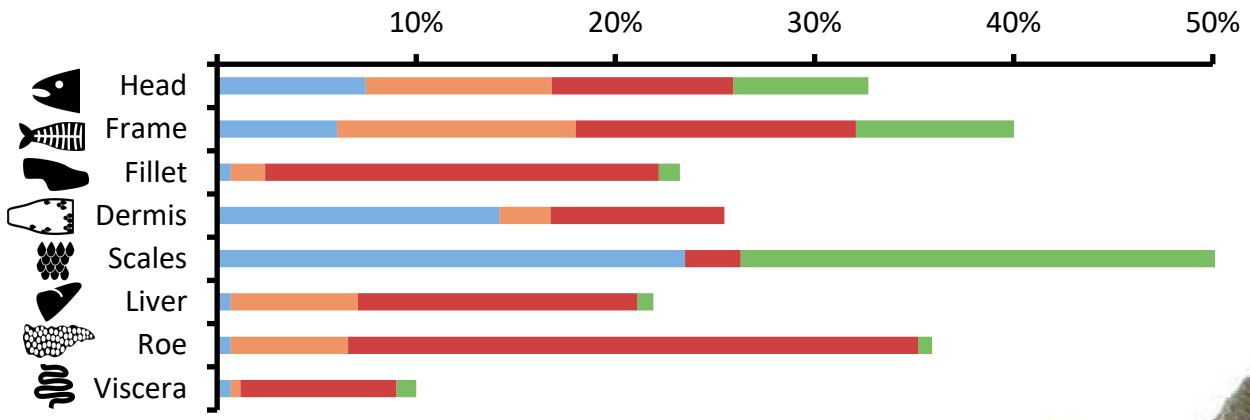
Legend	Scale
Collagen	= 10 tons/year
Oil	= 25 tons/year
Protein	= 100 tons/year
Mineral	= 1 ton/year

Yearly biomass distribution

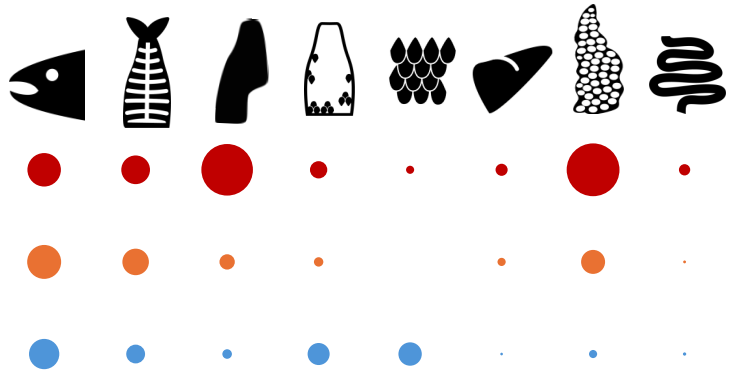


Slide 12 : Yellow perch slide

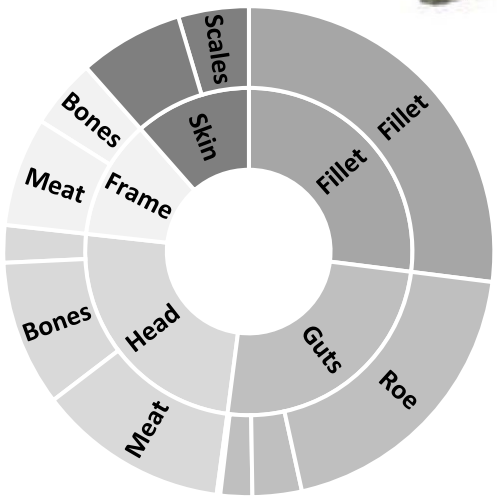
Anatomical composition



Biomass harvested yearly

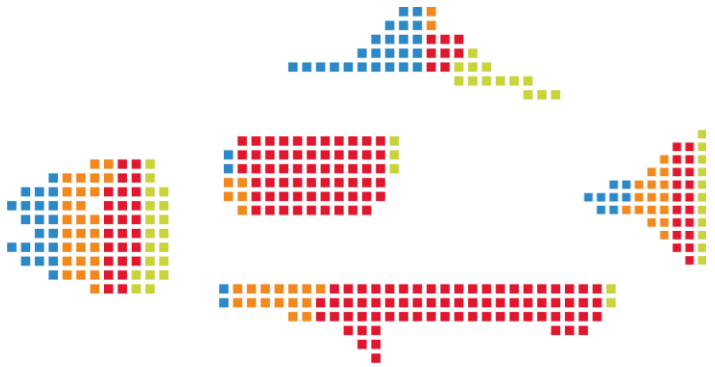


Anatomical breakdown



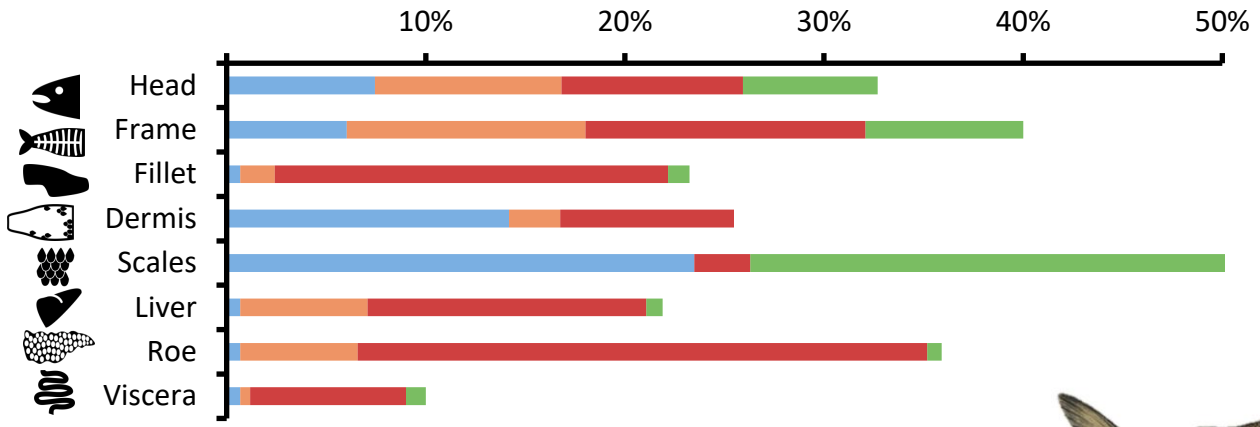
Legend	Scale
Collagen	= 10 tons/year
Oil	= 25 tons/year
Protein	= 100 tons/year
Mineral	= 1 ton/year

Yearly biomass distribution

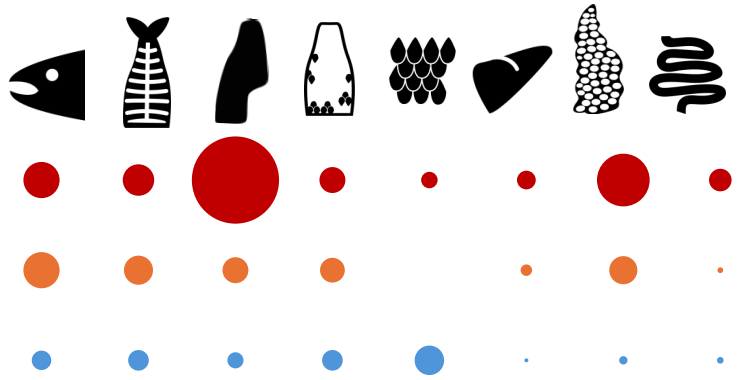


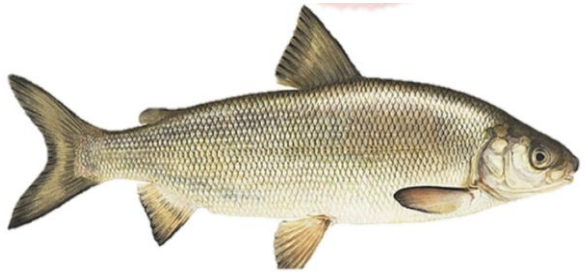
Slide 13 : Whitefish slide

Anatomical composition

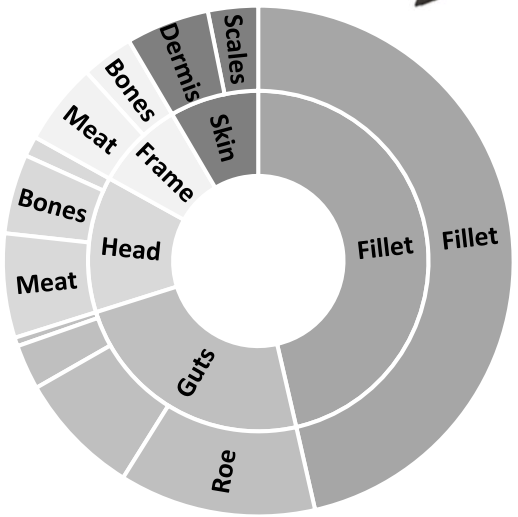


Biomass harvested yearly



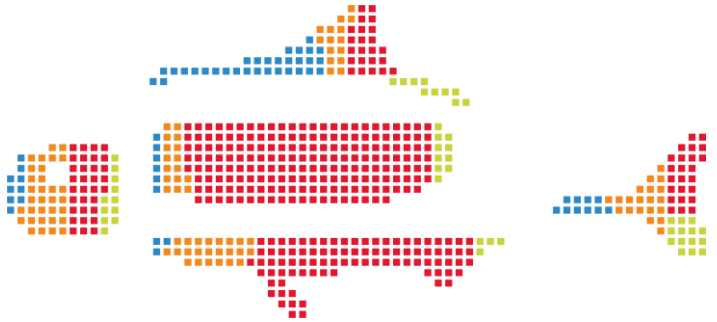


Anatomical breakdown



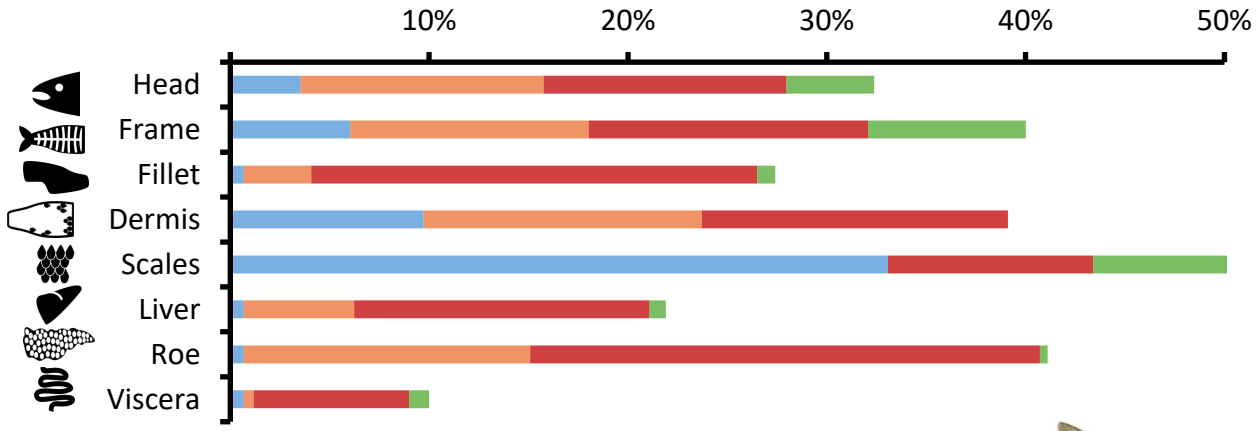
Legend	Scale
Collagen	= 10 tons/year
Oil	= 25 tons/year
Protein	= 100 tons/year
Mineral	= 1 ton/year

Yearly biomass distribution

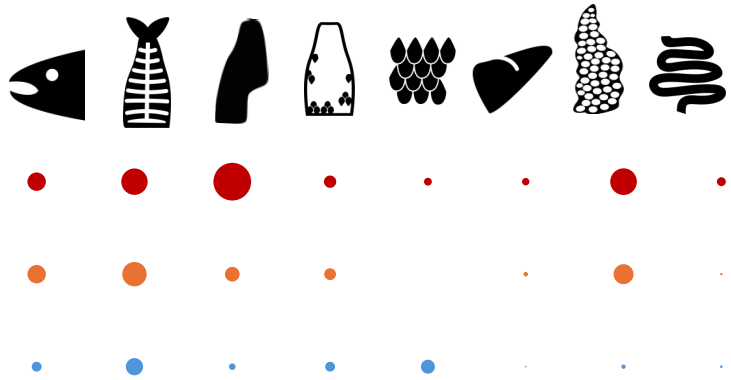


Slide 14 : Cisco slide

Anatomical composition



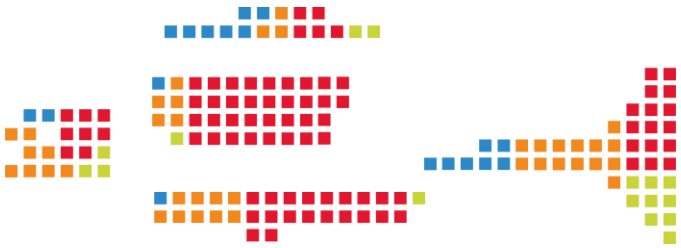
Biomass harvested yearly



Anatomical breakdown

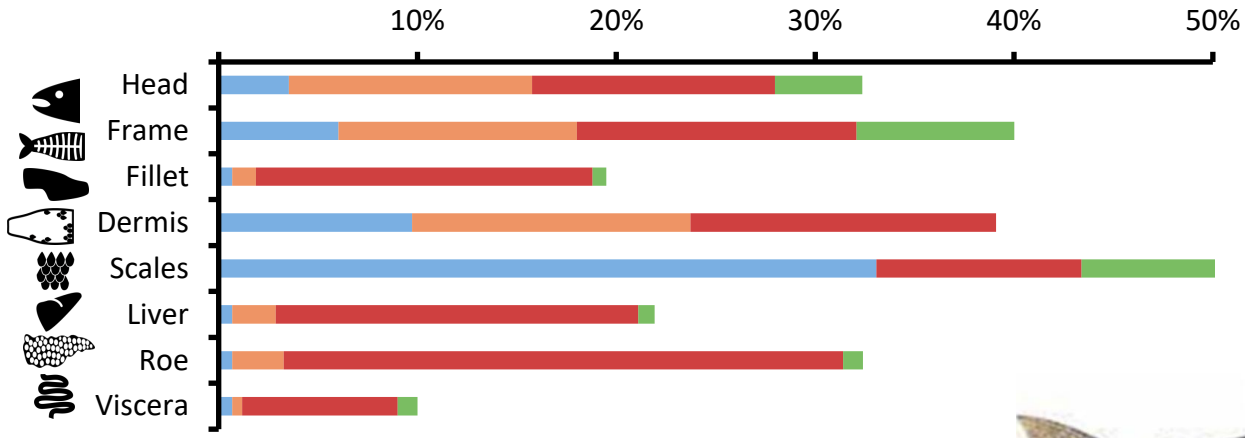
Legend	Scale
Collagen	= 10 tons/year
Oil	= 25 tons/year
Protein	= 100 tons/year
Mineral	= 1 ton/year

Yearly biomass distribution

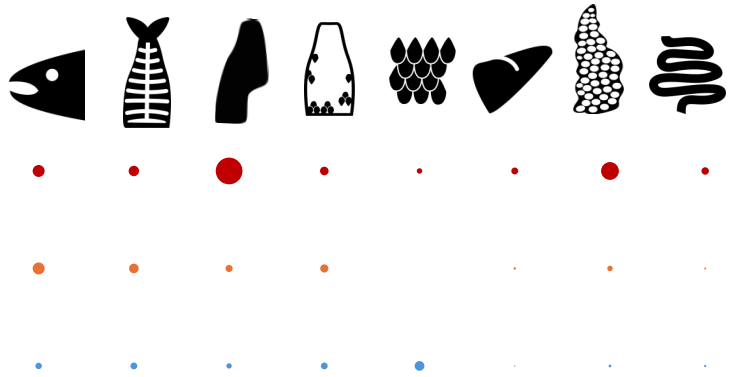


Slide 15 : Lake trout slide

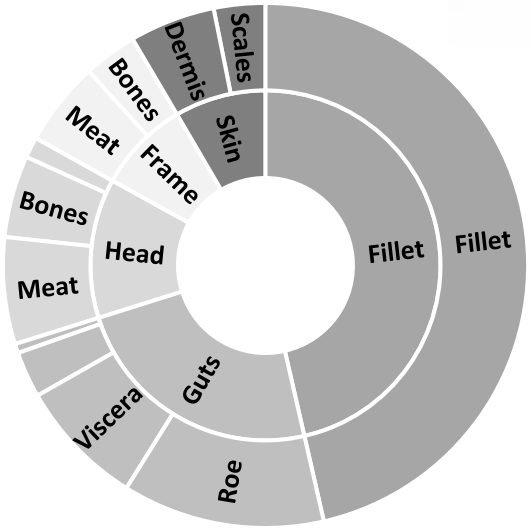
Anatomical composition



Biomass harvested yearly

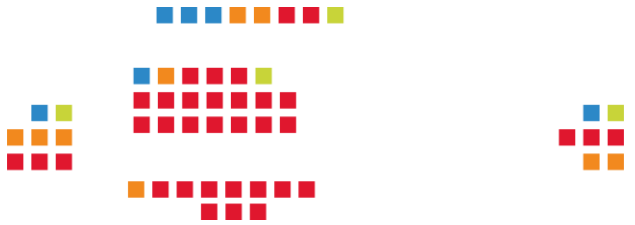


Anatomical breakdown



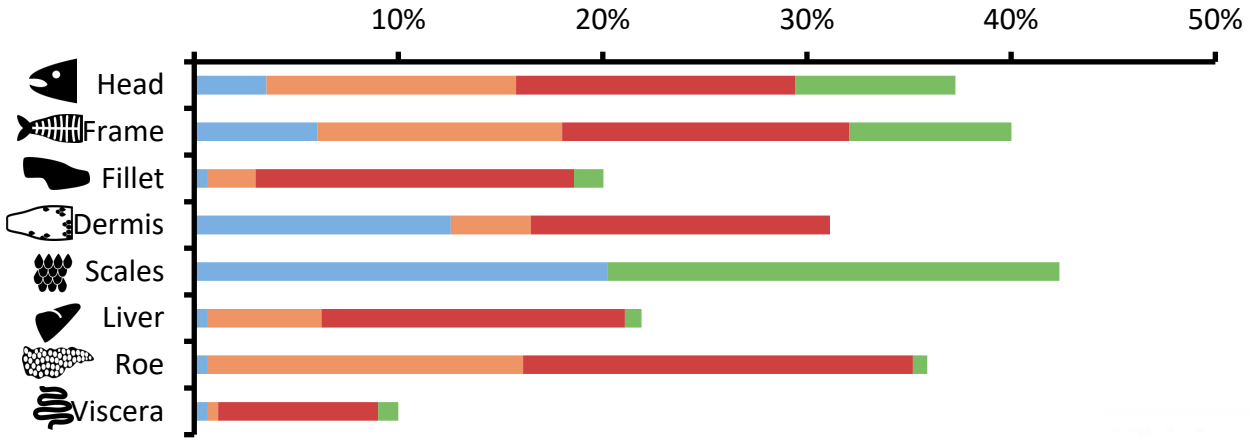
Legend	Scale
Collagen	= 10 tons/year
Oil	= 25 tons/year
Protein	= 100 tons/year
Mineral	= 1 ton/year

Yearly biomass distribution

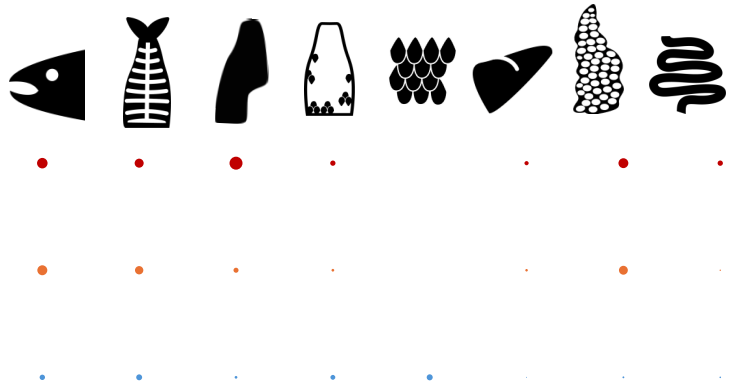


Slide 16 : White sucker slide

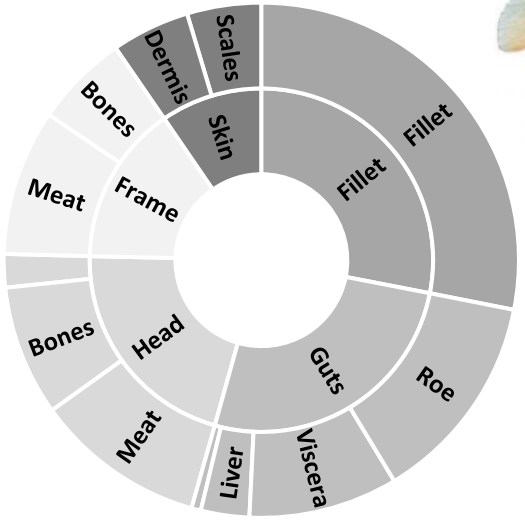
Anatomical composition

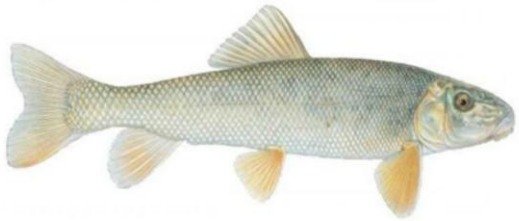


Biomass harvested yearly



Anatomical breakdown

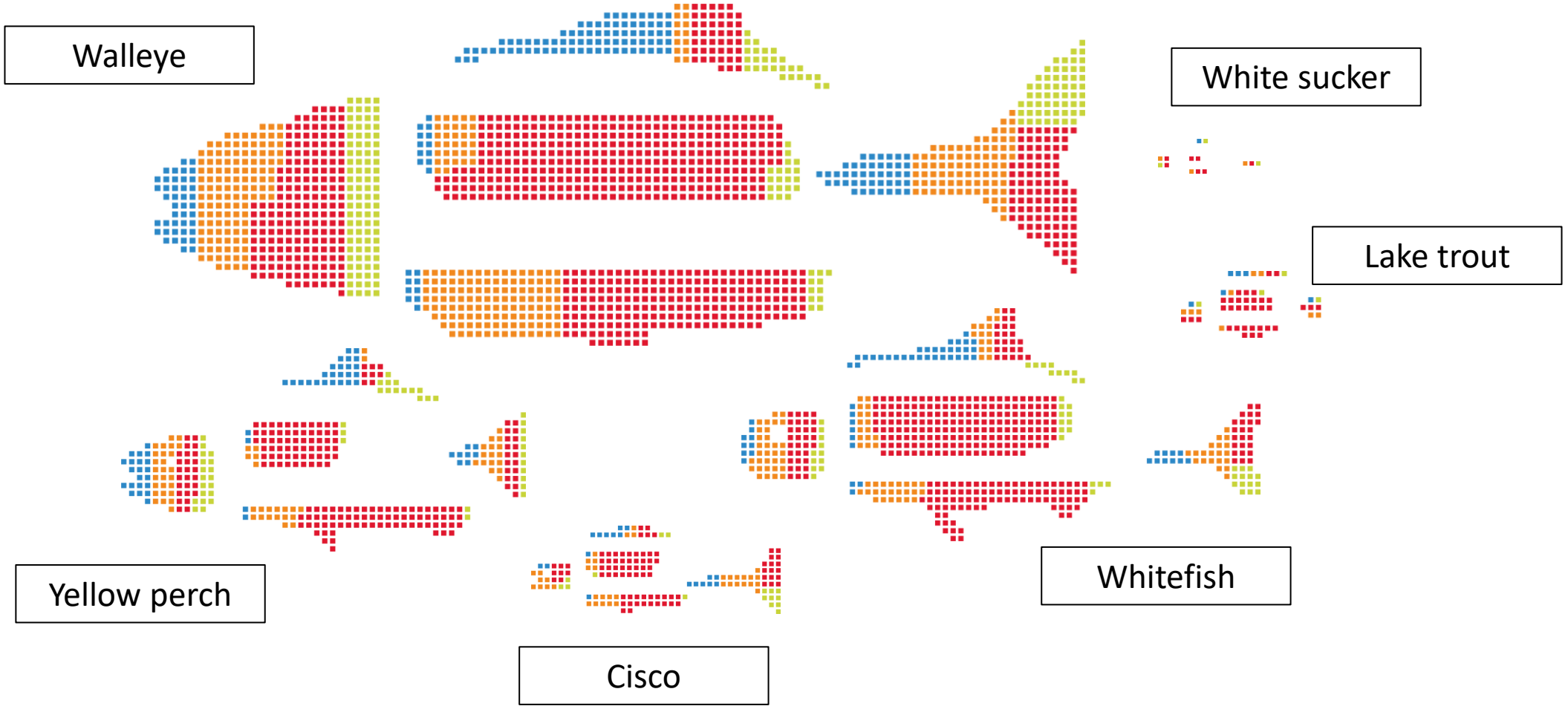




Yearly biomass distribution

Legend	Scale
Collagen	= 10 tons/year
Oil	= 25 tons/year
Protein	= 100 tons/year
Mineral	= 1 ton/year

Slide 17 : All harvested biomass



Collagen Oil Protein Mineral = 1 ton/year