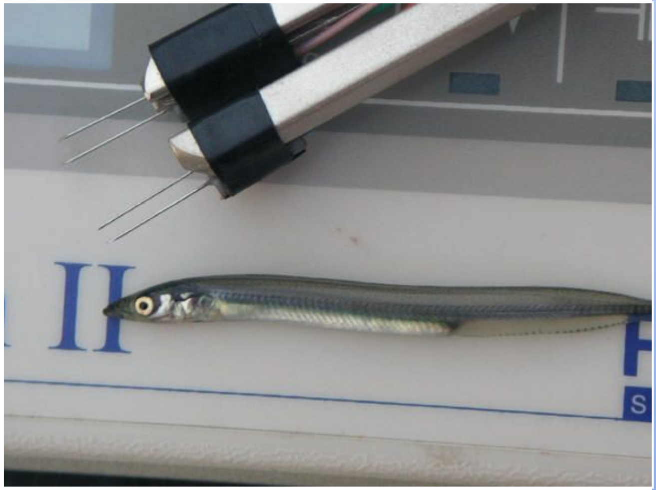
Alaska Seafood and the importance of bioimpedance current and future applications

Marlin Keith Cox - Bialume Tech Inc., Juneau AK (keith@bialume.com)

Christina Dewitt - Oregon State University, Astoria OR

Pedro Bertemes Filho - Universidade do Estado de Santa Catarina

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Talkeetna
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Skagway
Juneau
Gulf of Alaska
Sitka
Ketchikan
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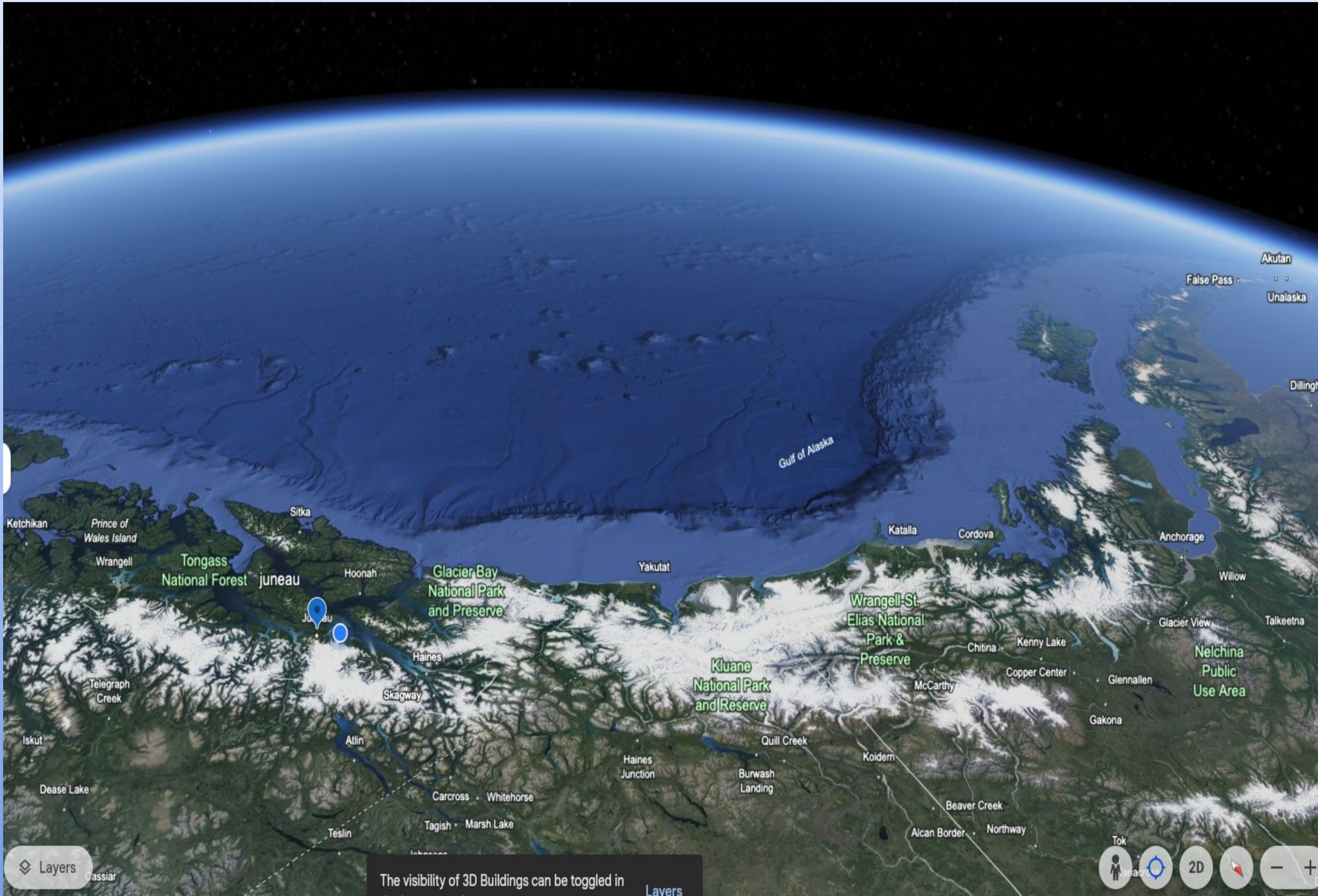
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Katalla
Cordova
Anchorage
Willow
Wrangell-St. Elias National Park & Preserve
Glacier View
Talkeetna
Chitina
Kenny Lake
Nelchina Public Use Area
Copper Center
Glennallen
Gakona
Kluane National Park and Reserve
McCarthy
Haines
Skagway
Telegraph Creek
Iskut
Atlin
Quill Creek
Koidern
Haines Junction
Burwash Landing
Dease Lake
Carcross
Whitehorse
Beaver Creek
Tagish
Marsh Lake
Teslin
Alcan Border
Northway
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The visibility of 3D Buildings can be toggled in the layers panel
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Lutak
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Mud Bay
Pike
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Inklin
Icefield
Tulsequah
Excursion Inlet
Juneau
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Lutak
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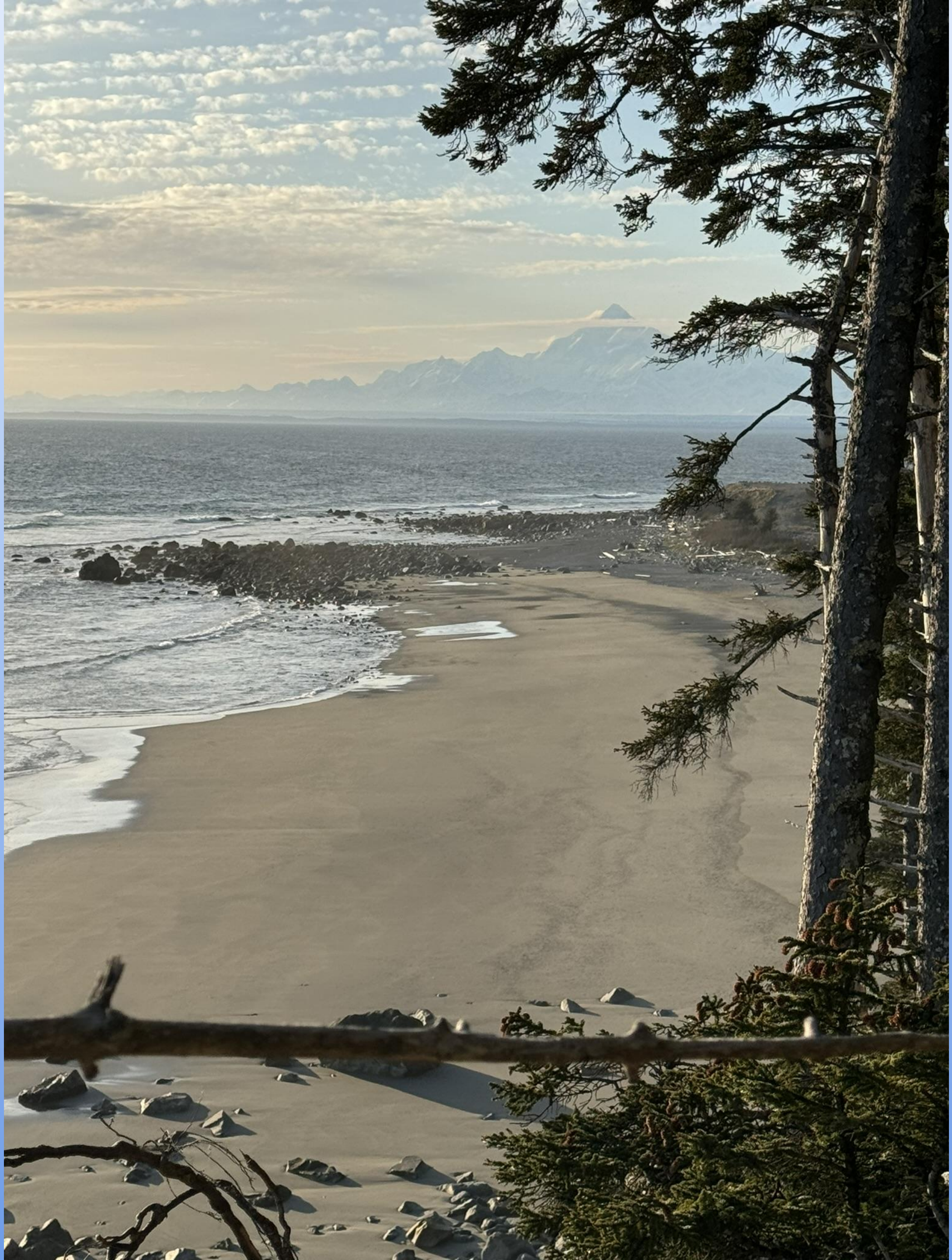
20 km


1.4km deep
30 meters of snow
per year and no rain


2km



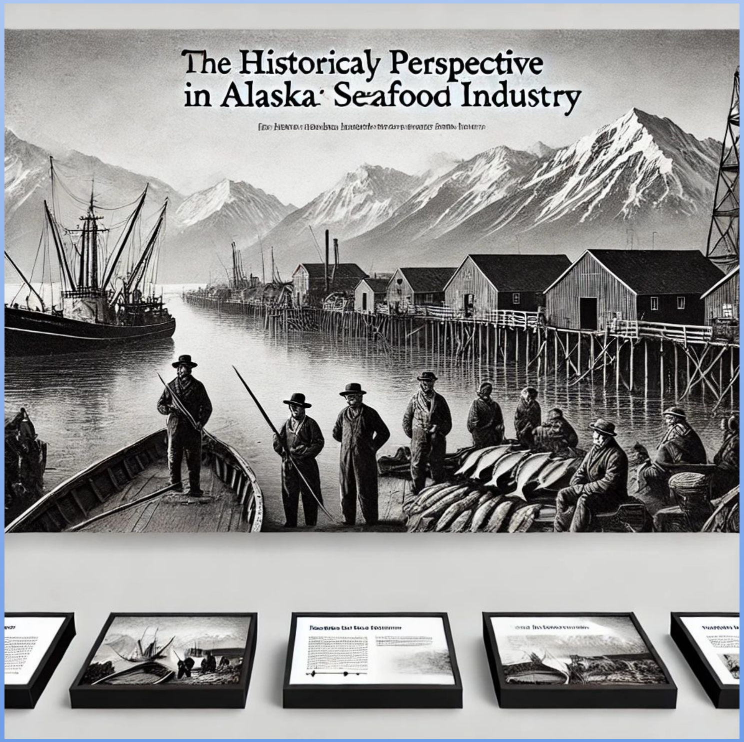



Alaska Seafood

1. Annual Harvest: Over 5 billion pounds of seafood harvested annually.
2. Economic Value: Valued at approximately $6 billion annually.
3. Employment: Provides over 60,000 jobs.
4. Wild Salmon: Over 95% of wild salmon in the U.S. comes from Alaska.
5. Halibut: Alaska produces over 80% of North America's wild halibut.
6. Export: 60% of Alaska seafood is exported globally.
7. Pollock: Alaska pollock fishery is the largest by volume in the U.S.
8. Crab: Home to world-famous King, Snow, and Dungeness crab, with millions of pounds harvested annually.

Historic Seafood in Alaska

- Indigenous communities have relied on seafood for thousands of years, forming the backbone of their sustenance and culture.
- Salmon, halibut, and shellfish were traditionally harvested using sustainable practices.
- The late 19th century saw the rise of commercial fishing, driven by the establishment of canneries.
- Early challenges included overfishing, limited regulations, and the depletion of key species.
- The 1959 Alaska Statehood Act mandated sustainable fisheries management, setting a global standard.



Alaska Seafood on the World Stage

Exports seafood to over 100 countries,
U.S.
Wild Alaska seafood is prized for its pu
Major export species include pollock, s
Plays a critical role in the global seafoo

Facing the Future

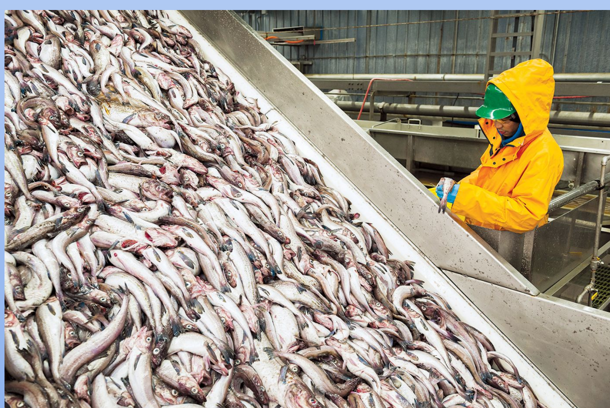
Challenges:

- Climate change affects fish populations and habitats.
- Increasing global competition in seafood markets.

Opportunities:

- Innovations in fishing technologies.
- Expanding markets for sustainably sourced seafood.
- Strengthening Alaska’s reputation as a leader in sustainability.

Pre-harvest Harvest Post-Harvest



So bioimpedance and aspects of food quality in terms of…..

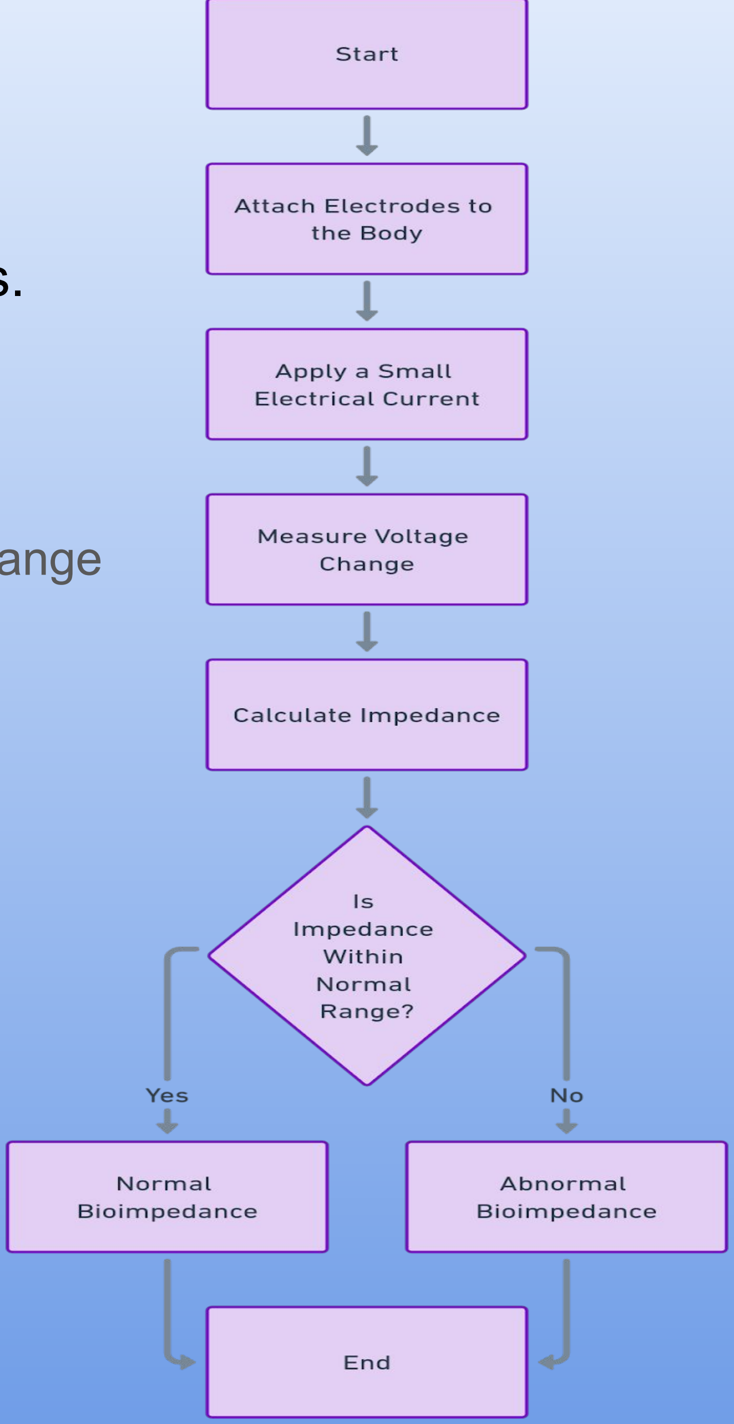
1. Pre harvest
2. Harvest
3. Future application

Who we are?

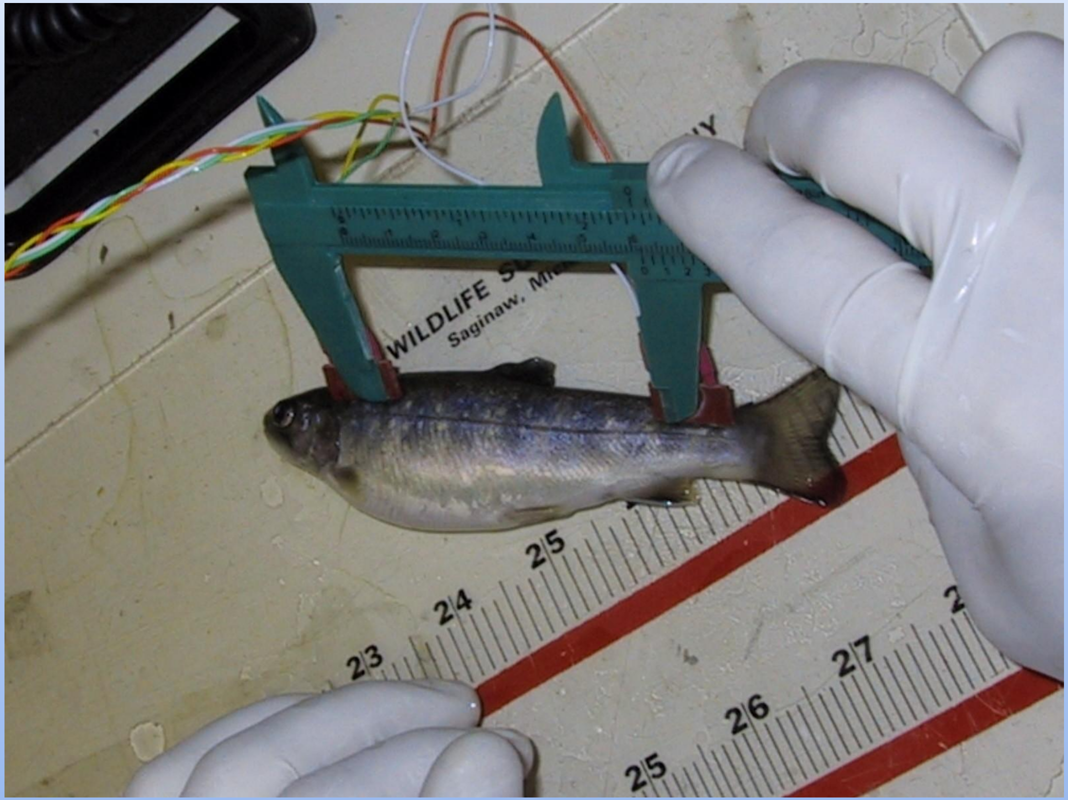
- CQFoods
- Previously Seafood Analytics
- We manufacture bioimpedance devices.

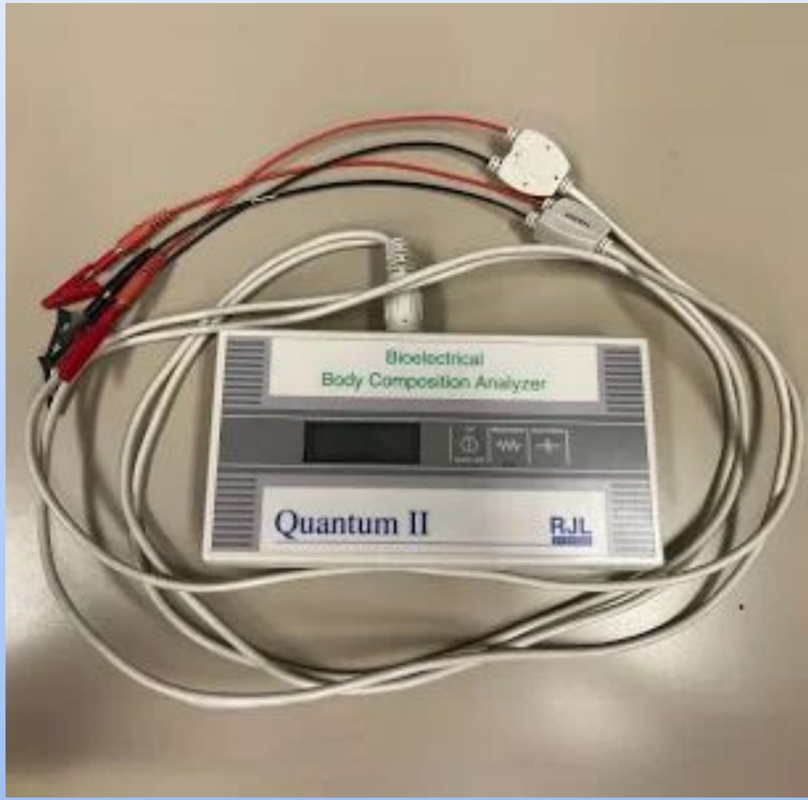
Single frequency
Measure voltage change

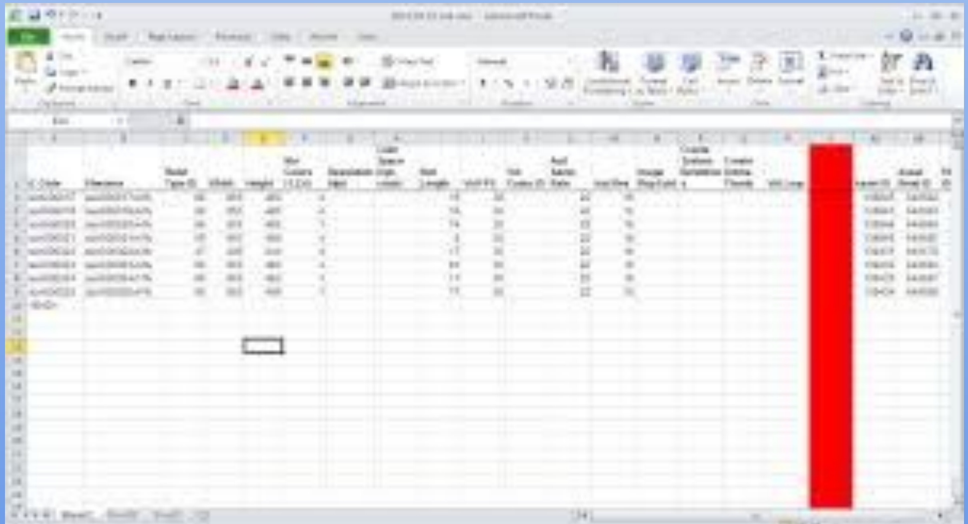
Cellular Measurements
Volume Changes
Body composition
Tissue classification
Tissue Monitoring



Pre harvest







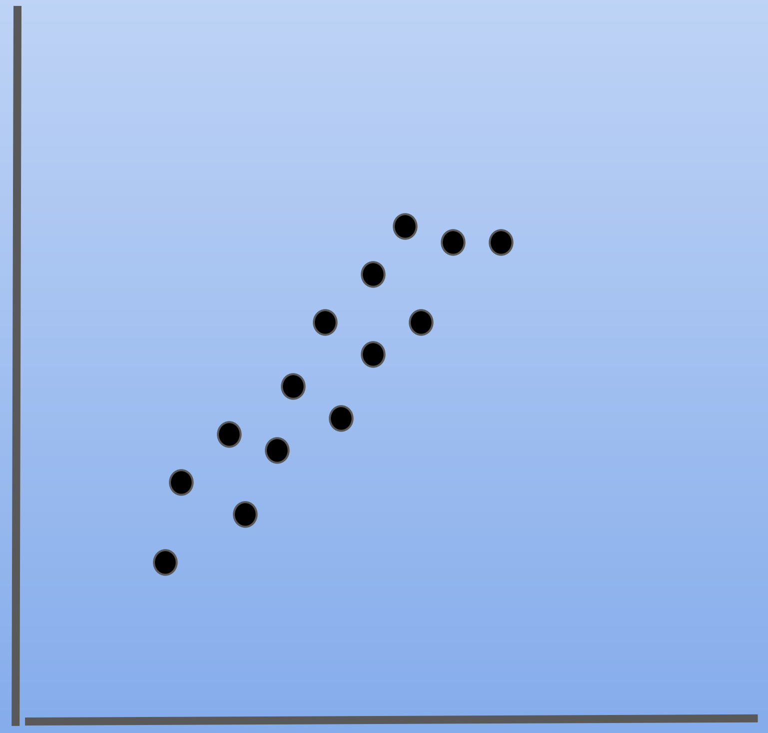
Can bioimpedance be used to track body composition in fish?

Methods

1. Lets use fish
2. Force them into different nutritional states
3. Measured resistance and reactance from 50 brook trout
4. Sacrificed the fish and measured body composition in lab
5. Compared the two values (perfect score = 1.0)
6. Used a 50kHz RJL System Quantum II.

Can we track body composition? First need a model?

Electrical equation

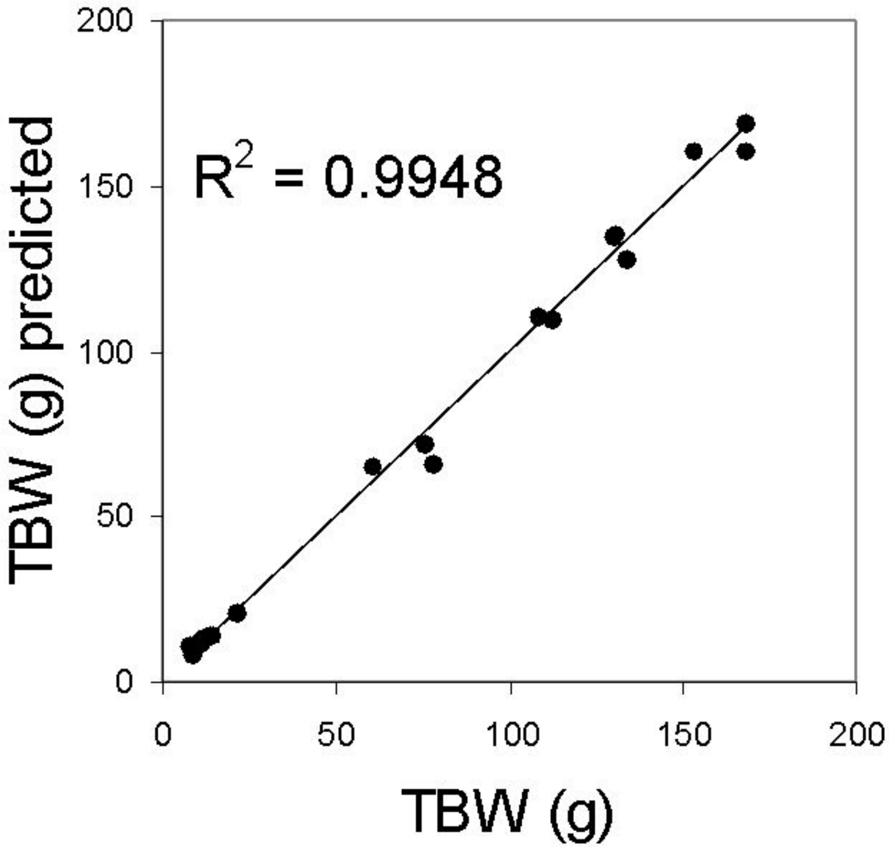


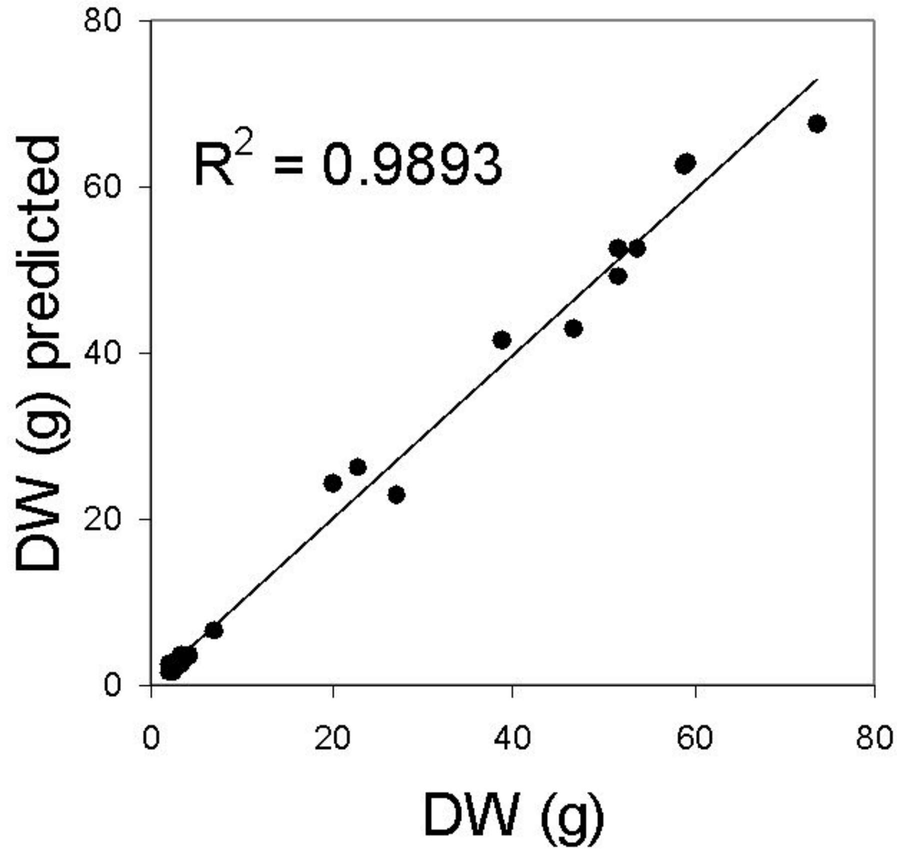
Fat, Protein, Water, Fat free mass

Pre harvest

Obtained	Name	Symbol	Electrical Equation	Volume Symbol	Electrical Volume Equation
Measured	Resistance in series	R	R	Rs_v	$Ld^2 \cdot R^{-1}$
Measured	Reactance in series	Xc	Xc	Xc_v	$Ld^2 \cdot Xc^{-1}$
Derived	Resistance in parallel	Rp	$R + (Xc^2 \cdot R^{-1})$	Rp_v	$Ld^2 \cdot Rp^{-1}$
Derived	Reactance in parallel	Xcp	$Xc + (R^2 \cdot Xc^{-1})$	Xcp_v	$Ld^2 \cdot Xcp^{-1}$
Derived	Capacitance (farad)	Cpf	$(1 \cdot 10^{-12}) \cdot (314000 \cdot Xcp)^{-1}$	Cpf_v	$Ld^2 \cdot Cpf^{-1}$
Derived	Impedance series	Zs	$Sqrt(R^2 + Xc^2)$	Zs_v	$Ld^2 \cdot Zs^{-1}$
Derived	Impedance parallel	Zp	$(Xc*R)/sqrt(Xc^2+R^2)$	Zp_v	$Ld^2 \cdot Zp^{-1}$
Derived	Phase angle (radians)	Phase angle	$Arctan \cdot (Xc \cdot R^{-1})$	na	na

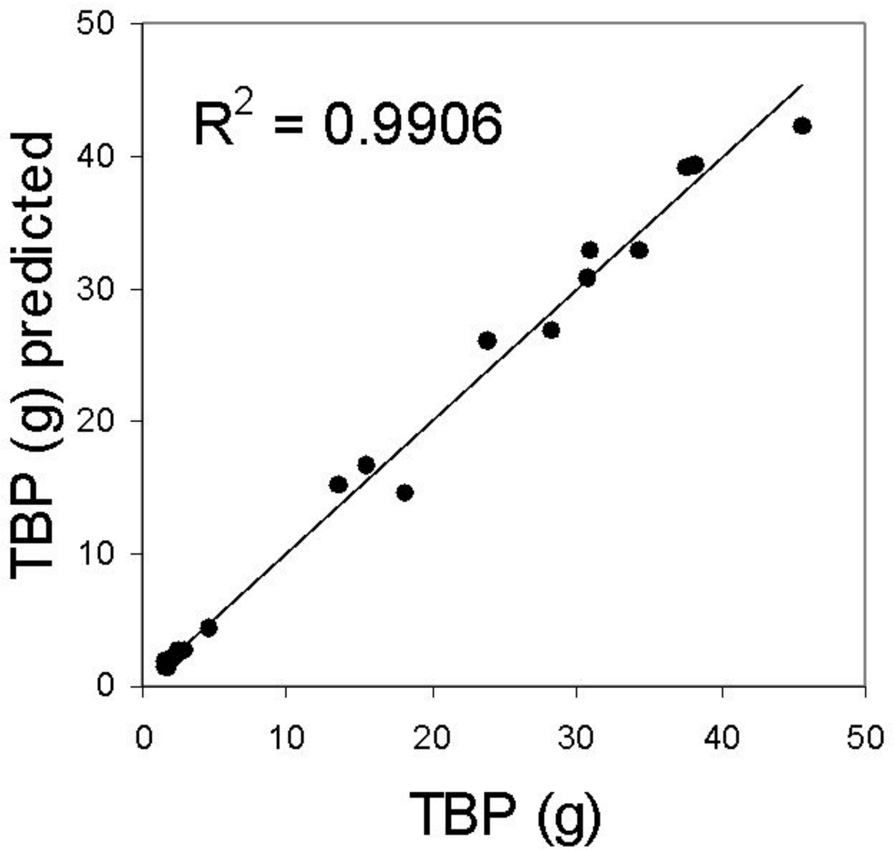
Total body water (TBW) and Dry weight (DW)

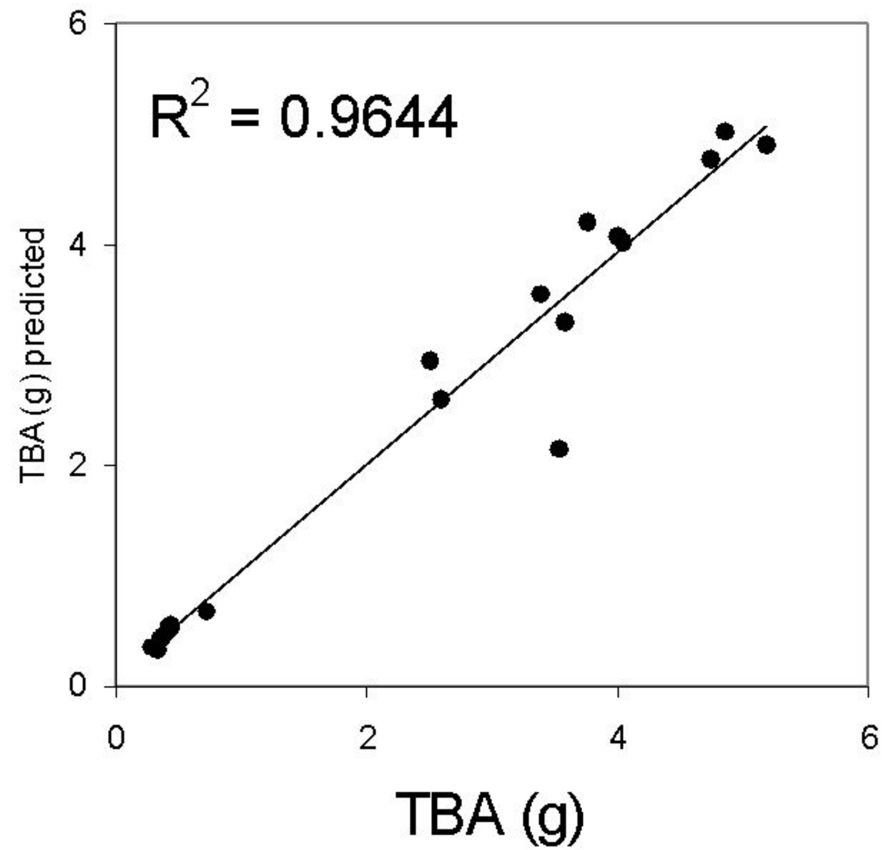




Pre harvest

Total body protein (TBP) and Total body ash (TBA)





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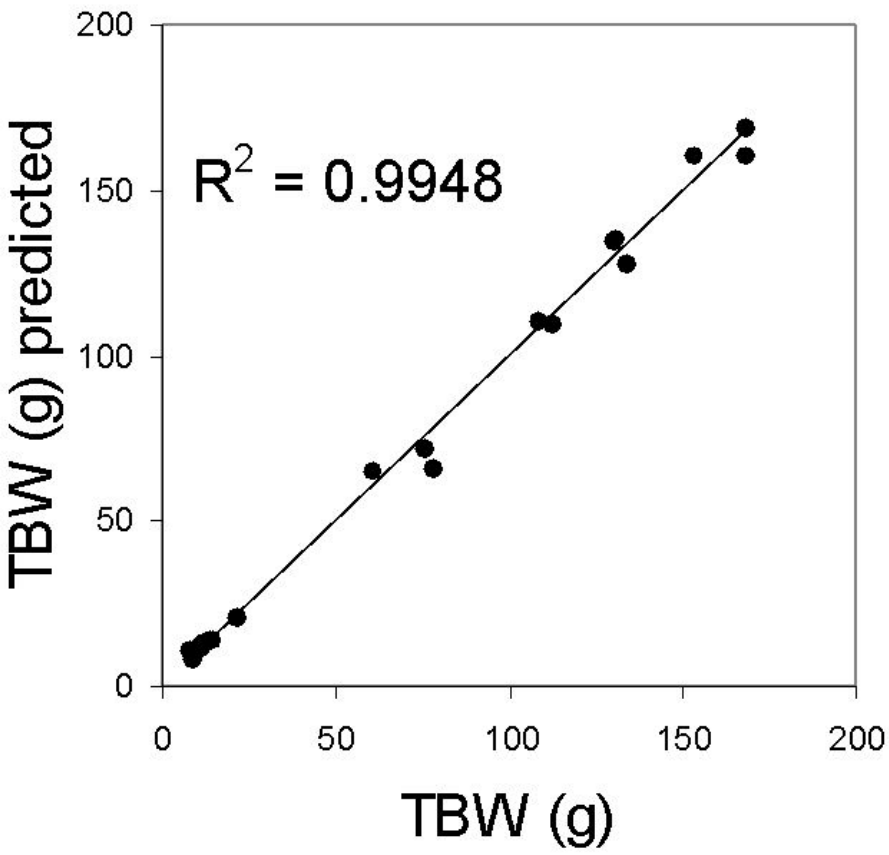

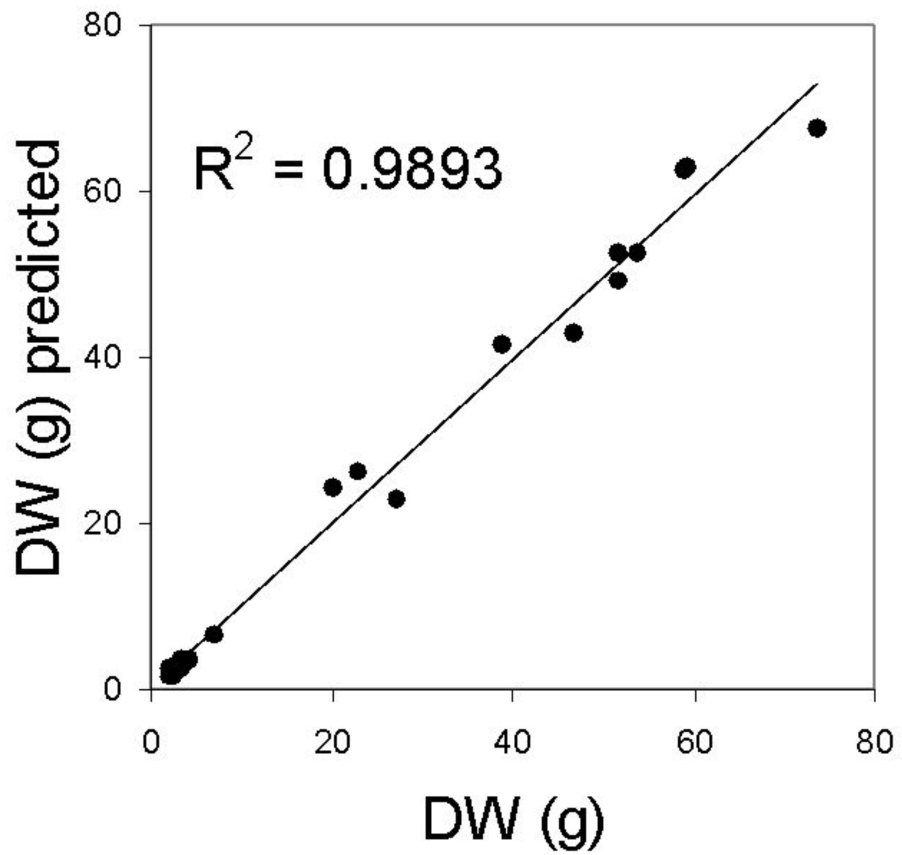

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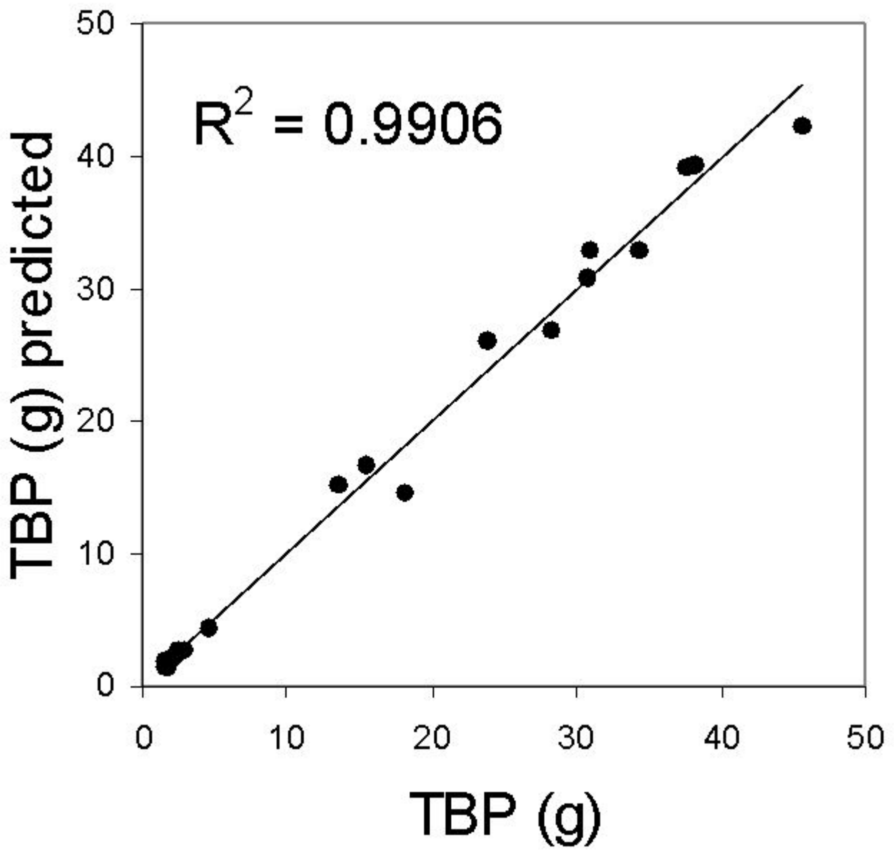

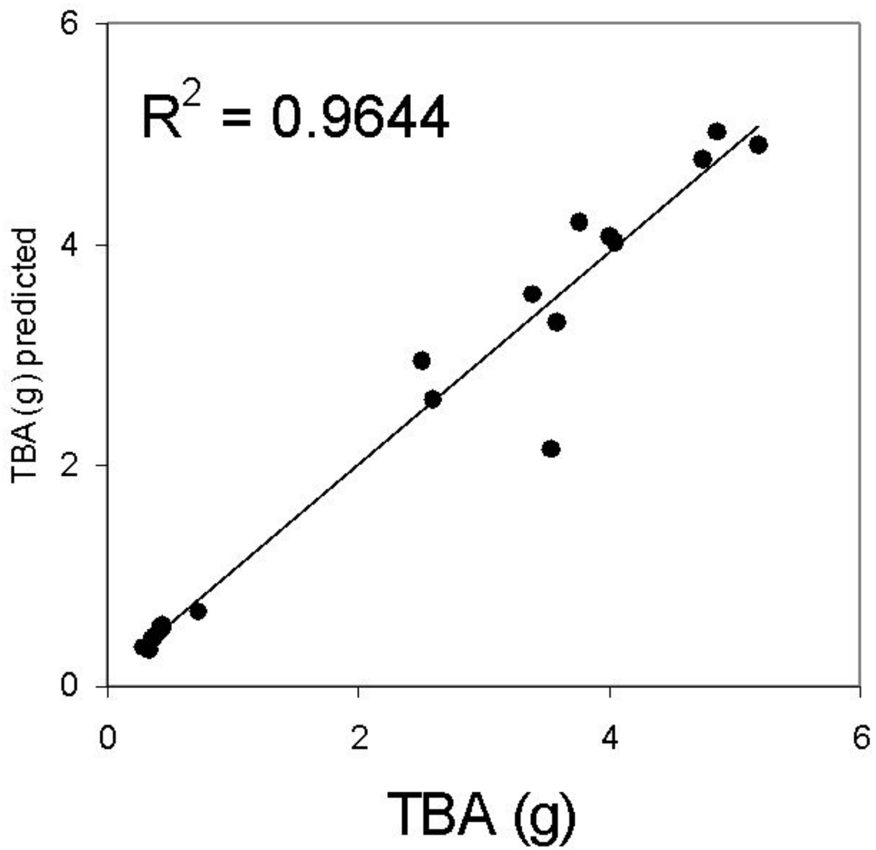

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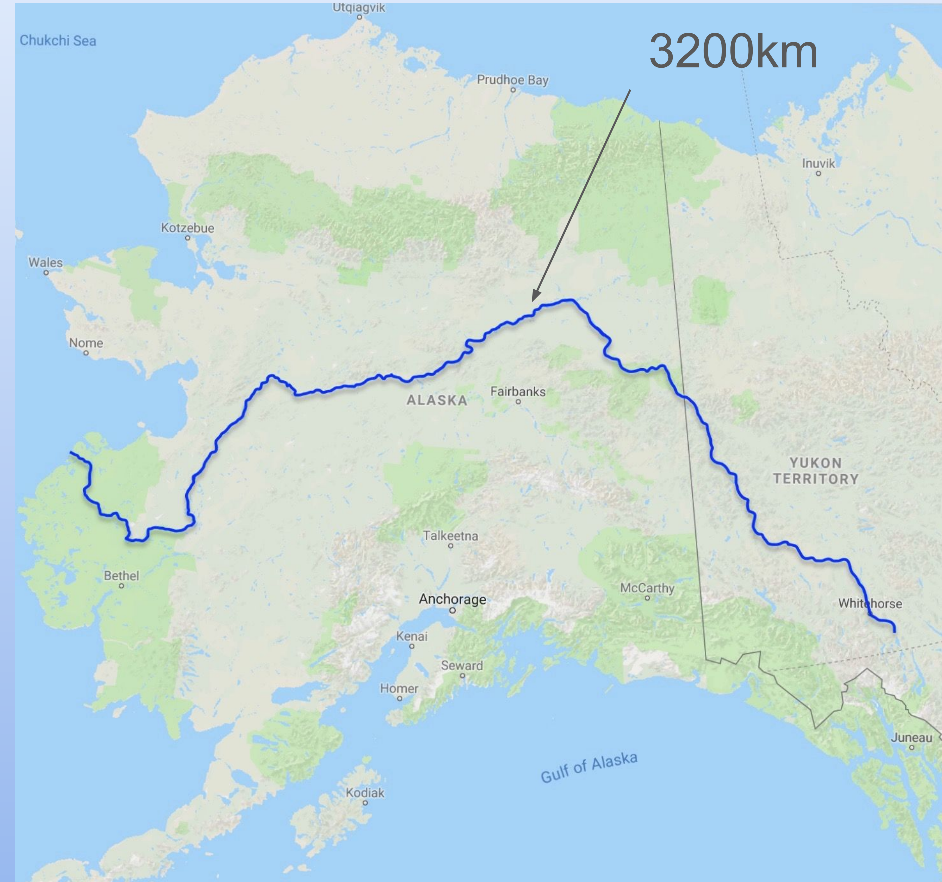
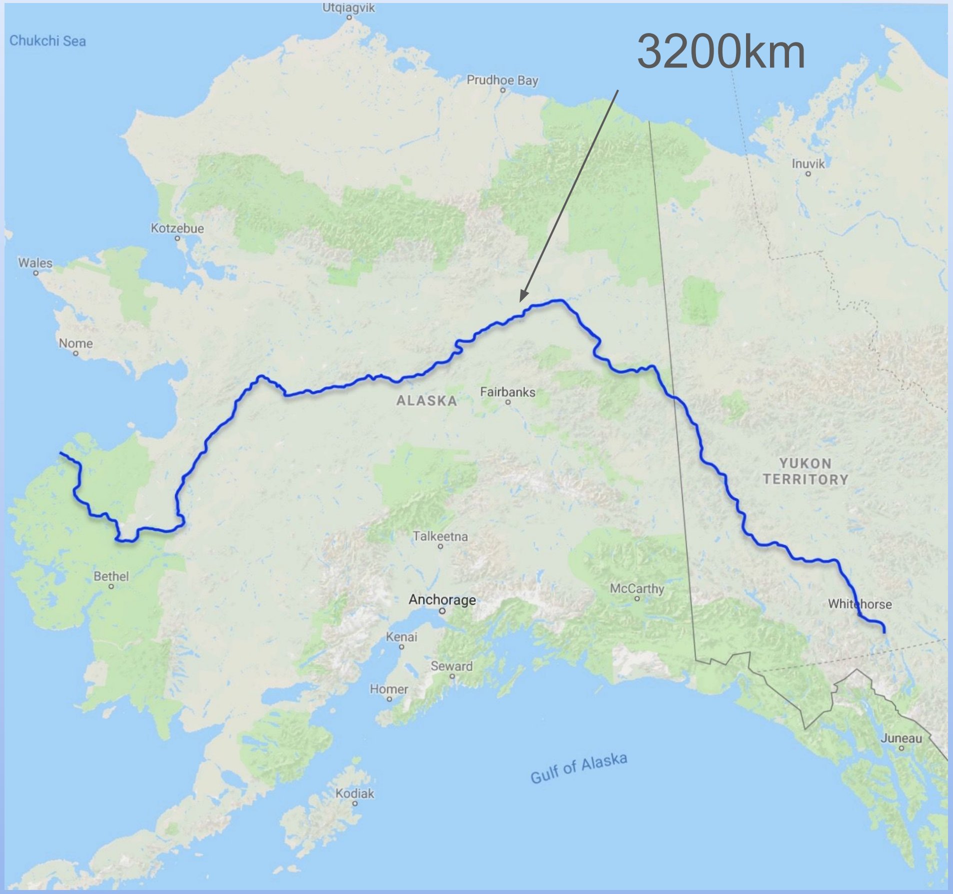

3200km
Utqiagvik
Chukchi Sea
Prudhoe Bay
Inuvik
Kotzebue
Wales
Nome
ALASKA
Fairbanks
YUKON TERRITORY
Talkeetna
Bethel
Anchorage
McCarthy
Whitehorse
Kenai
Seward
Homer
Juneau
Gulf of Alaska
Kodiak

Pre harvest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Bethel
Anchorage
McCarthy
Whitehorse
Kenai
Seward
Homer
Juneau
Gulf of Alaska
Kodiak

Pre harvest

https://youtu.be/IarZQFsDAiM

Pre harvest

Pre harvest

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Email address for contact author: Keith.Cox@noaa.gov

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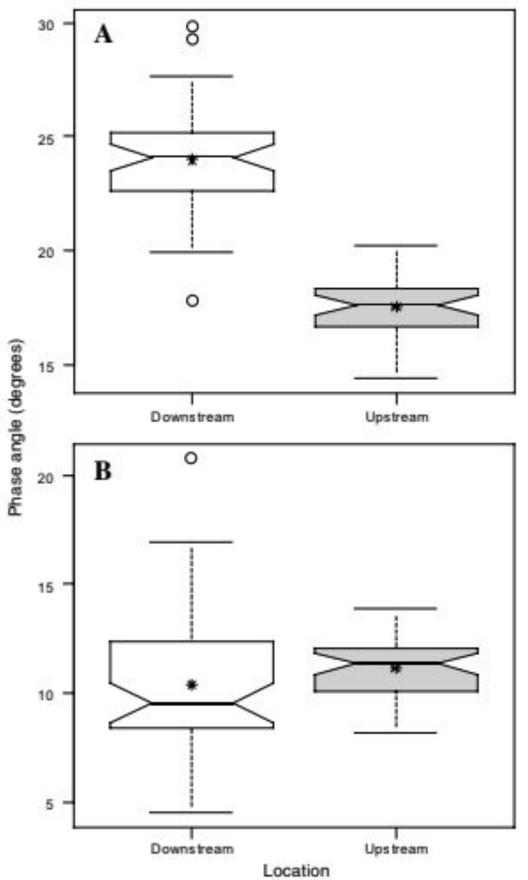

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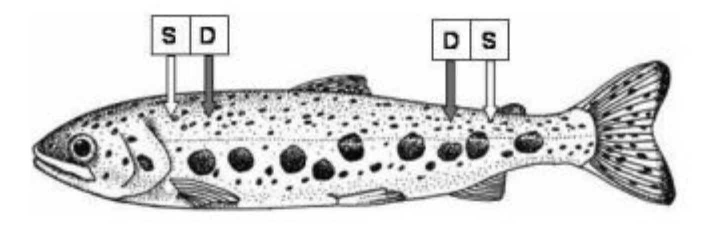
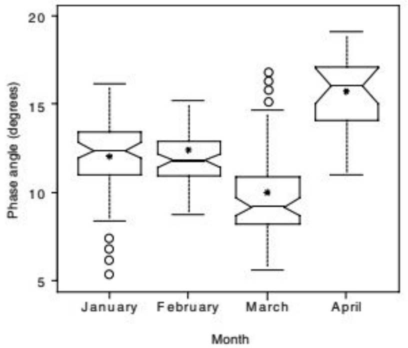
Notched boxplots of phase angles and means (*) calculated from bioelectrical impedance analysis measurements taken on the dorsal (**A**) and ventral (**B**) sides of chum salmon (*Oncorhynchus keta*) at both the mouth of the Yukon (downstream) (n=47) and 2000 km upstream (n=40). Notches extend to ±1.58 interquartile range/$\sqrt{n}$ and represent roughly 95% confidence intervals. Open circles (○) represent outliers determined by a Grubbs test.





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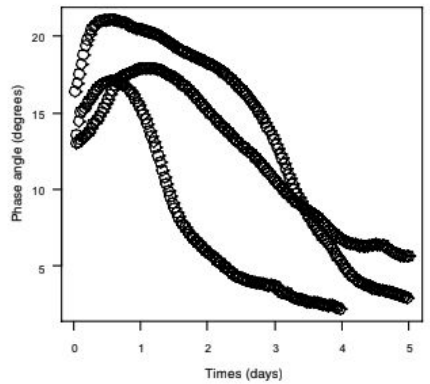

Figure 8

Phase angles for postmortem adult pink salmon (*Oncorhynchus gorbuscha*) (n=3) measured every 10 minutes for 5 days while stored at temperatures <11°C.

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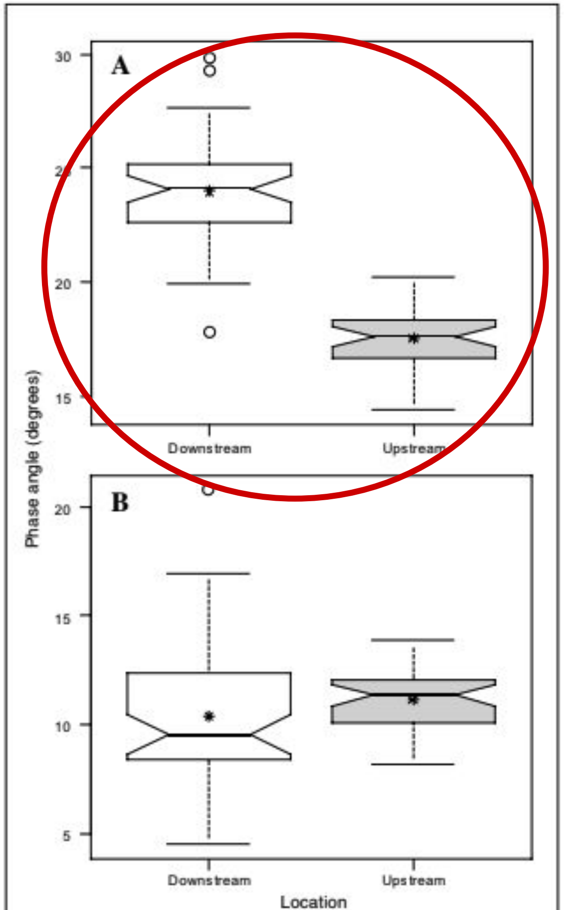

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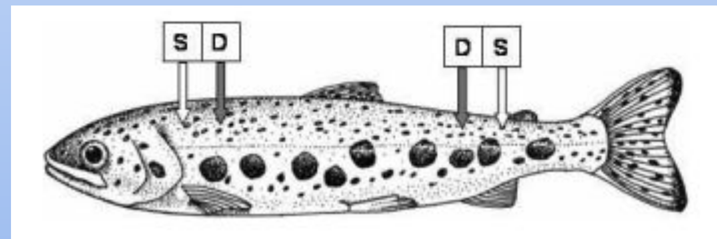

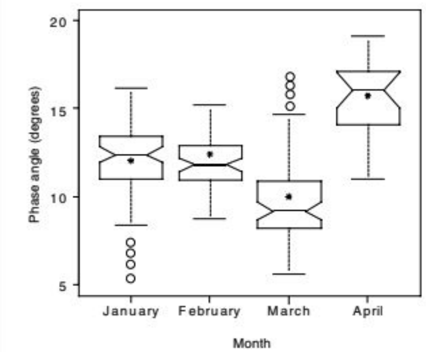

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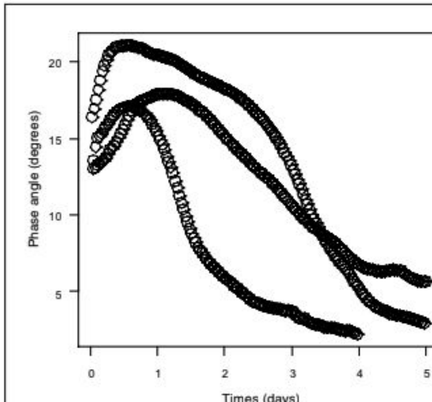

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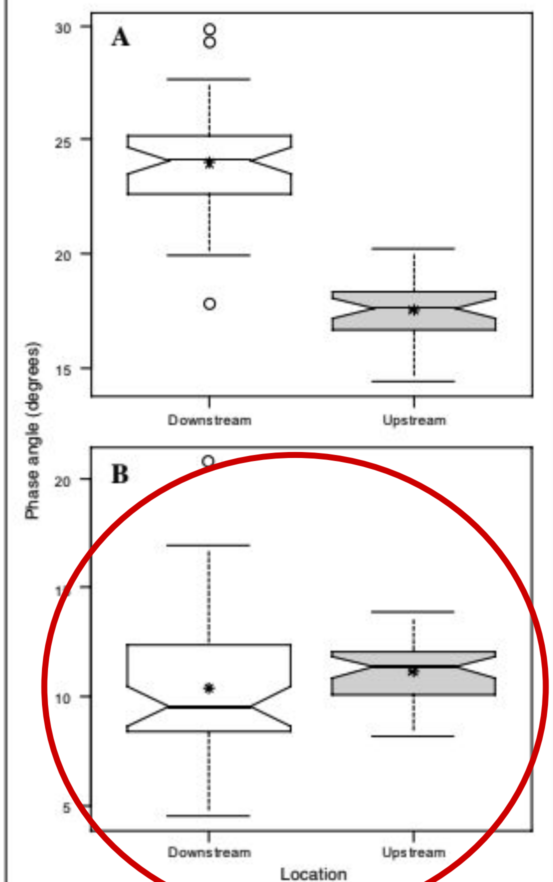

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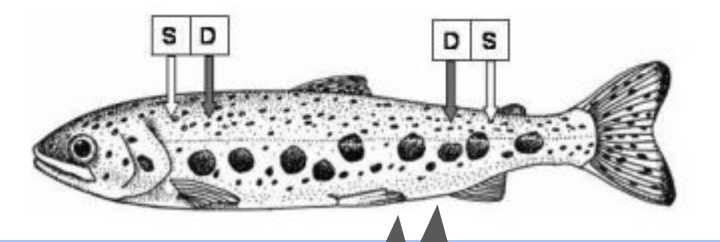

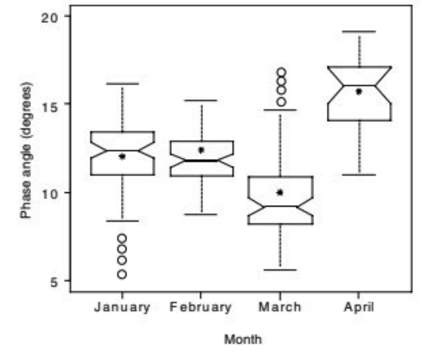

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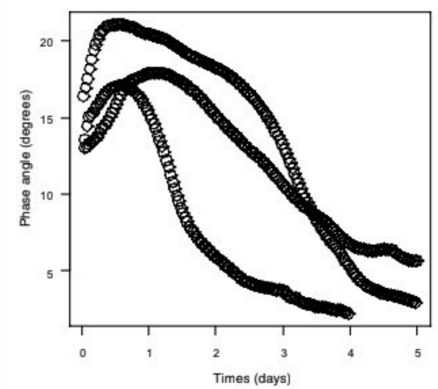

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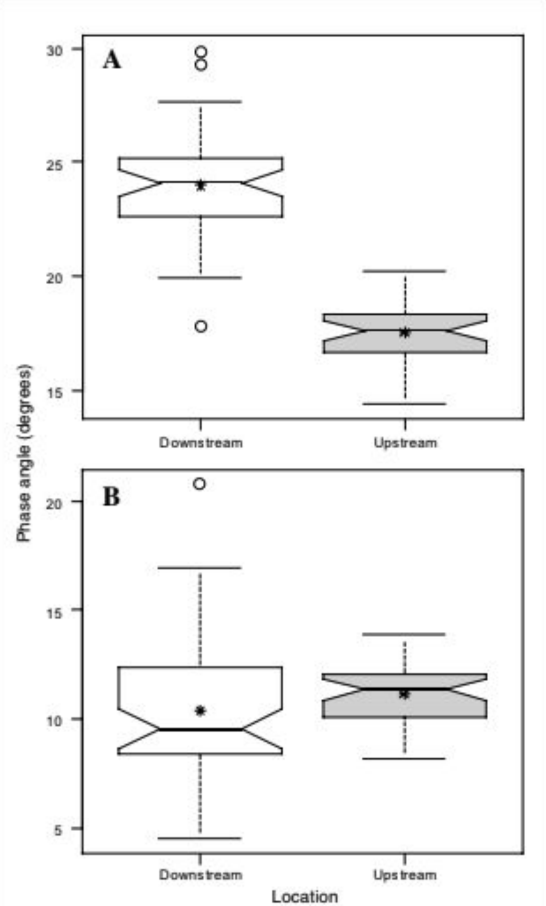

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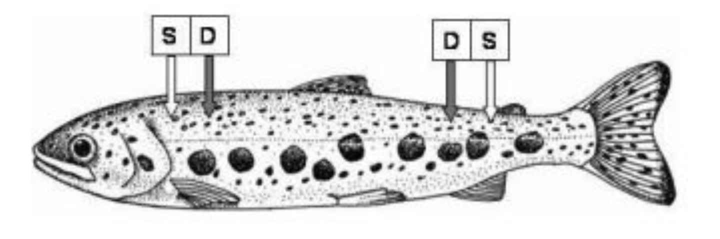

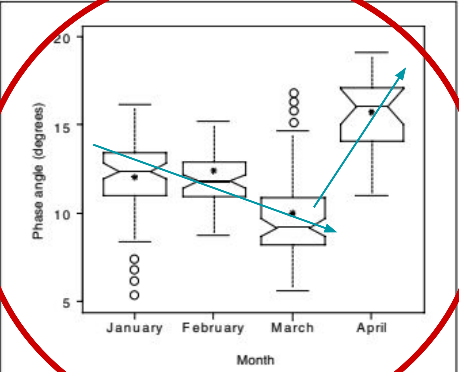

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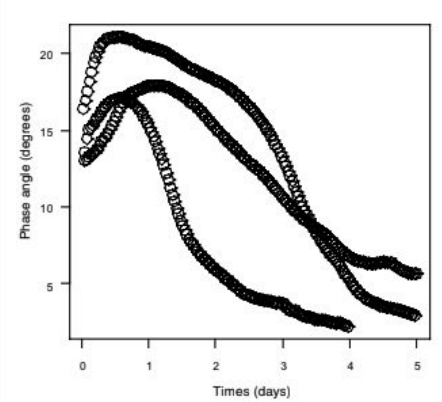

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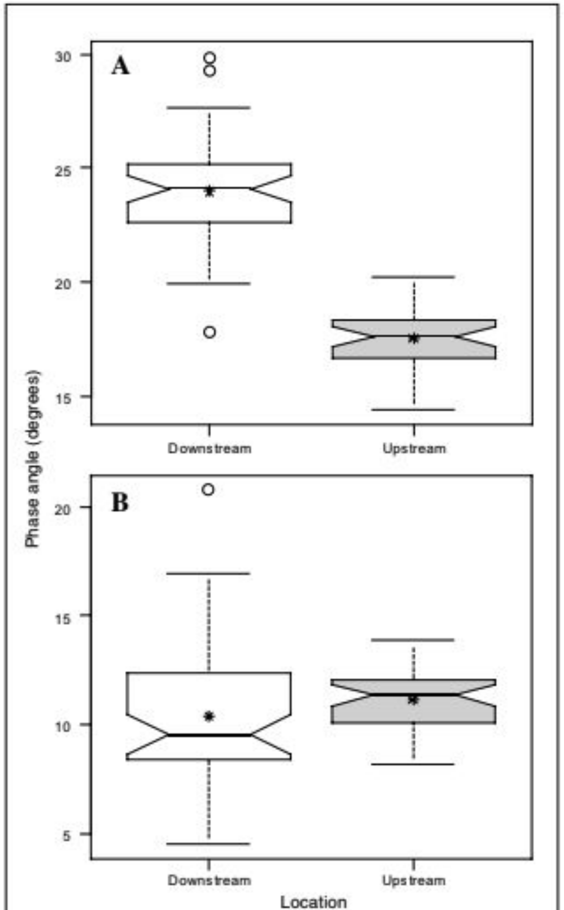

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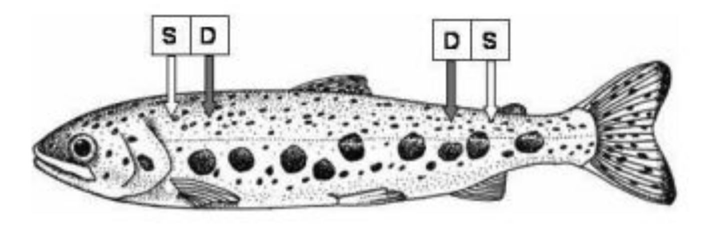
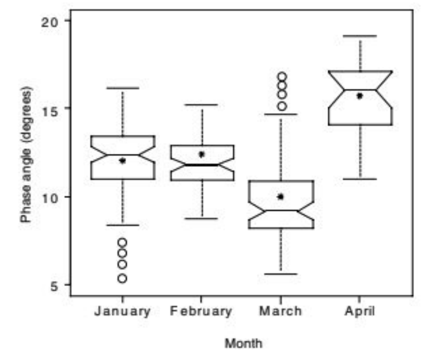


Measurements of resistance and reactance in fish with the use of bioelectrical impedance analysis: sources of error

M. Keith Cox (contact author)[1]
Ron Heintz[1]
Kyle Hartman[2]

Email address for contact author: Keith.Cox@noaa.gov

[1] National Marine Fisheries Service
Alaska Fisheries Science Center
Auke Bay Laboratories
11305 Glacier Hwy
Juneau, Alaska 99801



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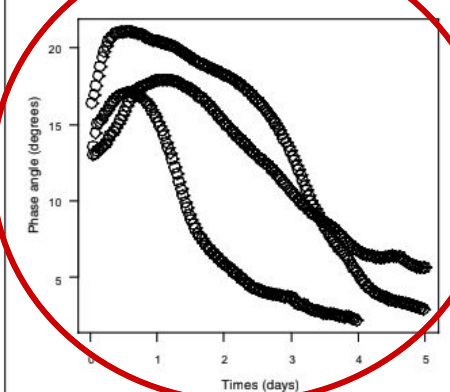

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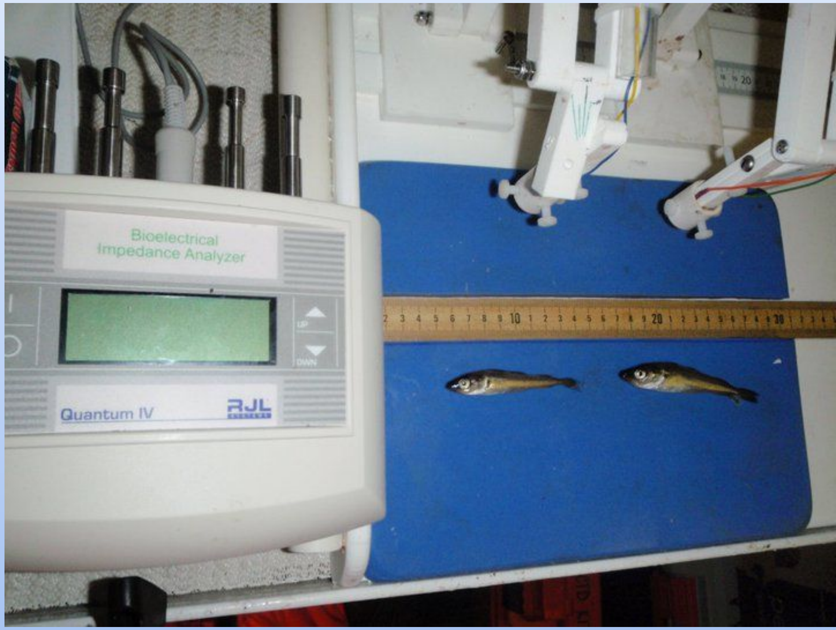
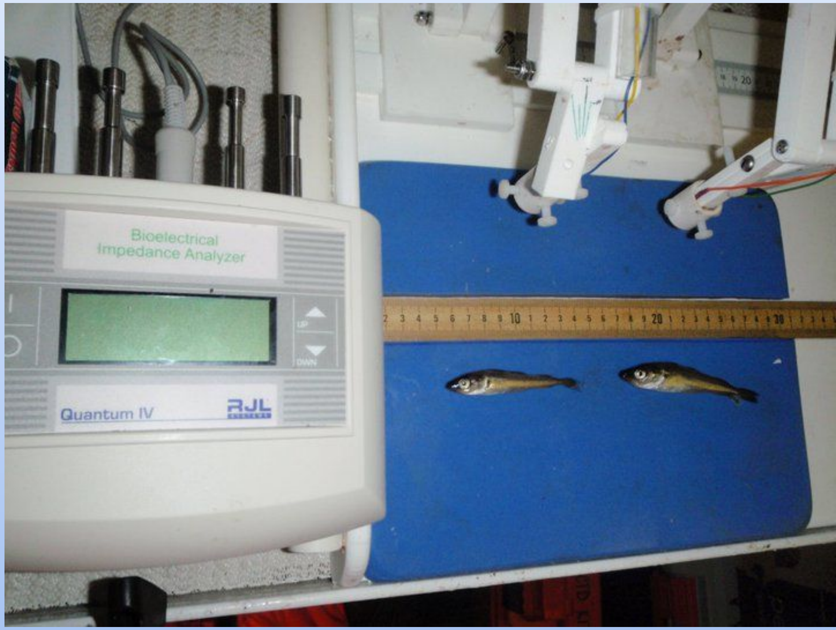
Pre harvest



Brook, rainbow, pollock, cod, Eulachon, herring, sand lace, shark, mullet, ocean perch, halibut, king, chum, pink, sockeye and silver salmon, rockfish, smolts, flounder, yellow eye snapper, catfish, bass, all using impedance.

Pre harvest


ARCTIC RAM


Bioelectrical
Impedance Analyzer
Quantum IV
RJL


NOAA Fisheries
NOAA
Alaska Fisheries
Science Center

Alaska Seafood Industry: Navigating a Financial Crisis

- Alaska’s seafood industry lost $1.8 billion from 2022 to 2023 (NOAA report).
- Environmental, economic, and regulatory challenges are driving the crisis.
- Ripple effects extend to jobs, local businesses, and global markets.

Environmental Challenges

- Rising ocean temperatures and shifting ecosystems are affecting key species.
- Significant impacts on salmon, crab, and other fisheries.
- Habitat degradation disrupting traditional fishing patterns.

Economic Pressures

- Increased competition in global seafood markets has driven down prices.
- Rising fuel and labor costs are straining fishing operations.
- Reduced profitability threatens the sustainability of the industry.
- The U.S. fisheries model focuses on volume rather than quality, creating added challenges in premium markets.

Regulatory Challenges

- Fishery closures and quota reductions to protect declining populations.
- Strict regulatory measures are limiting harvests, exacerbating financial pressures.

Impact on Industry and Jobs

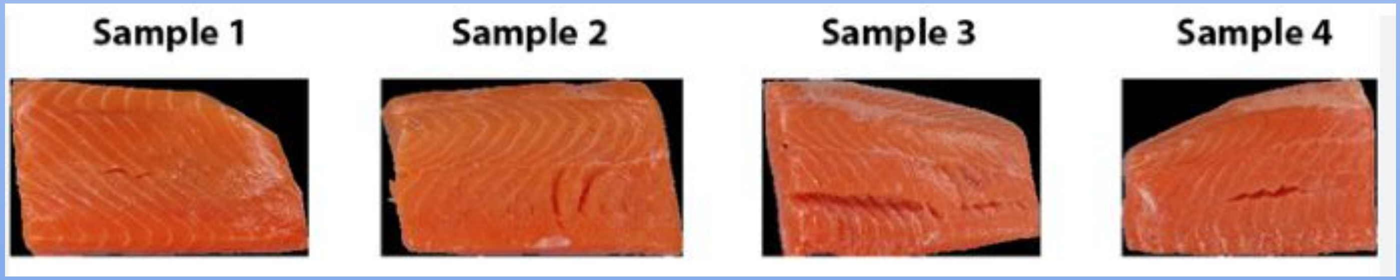
- Nearly 7,000 job losses in Alaska’s seafood sector.
- Ripple effects on local businesses, seafood processors, and transportation industries.
- Decline in economic activity in coastal communities.

Responses and Future Outlook

- Government task force to address the crisis; policy recommendations expected by January.
- Industry efforts include diversification, investment in sustainable practices, and exploring new markets.
- A long road ahead requiring coordination and innovation.
- Creating a quality vs. volume fishery.

Why is quality an issue.

- Shortens shelf life
- Value can decrease but only at the end
- Once quality is lost it is not regained
- Dock prices are low



Measuring quality by smell

Sweet
Seaweed
Cucumber
Melon
Mild
Neutral
Metallic
Fresh Cut
Grass
Briny
Fishy
Ammonia
Sour
Sulfurous

Rancid
Musty
Putrid
Fruity (overripe)
Chemical
Medicinal
Garlic-like
Cabbagy
Oniony
Yeasty
Vinegar-like
Bleach-like
Toffee
Caramel
Burnt
Sweaty
Leather-like
Earthy
Barnyard
Manure-like

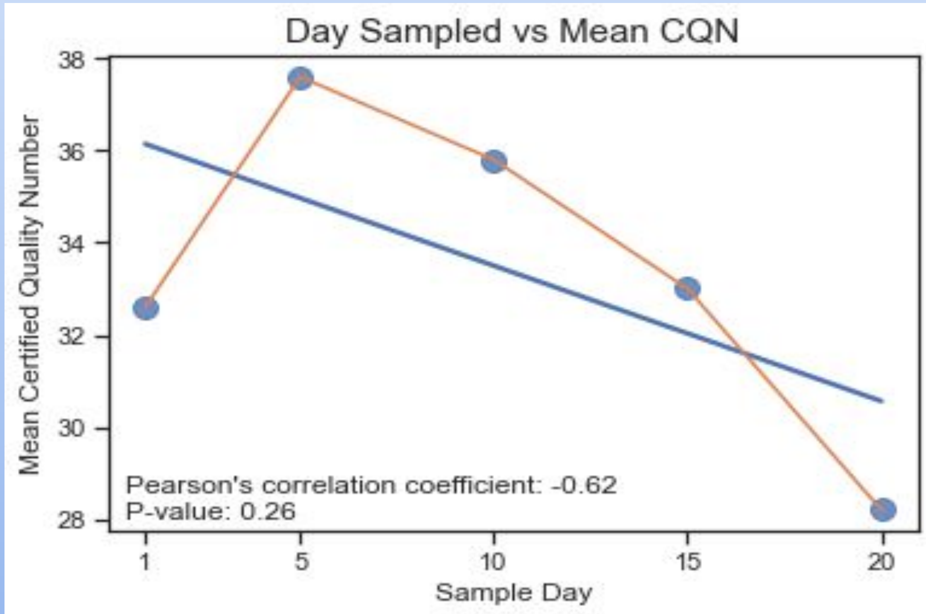
Harvest

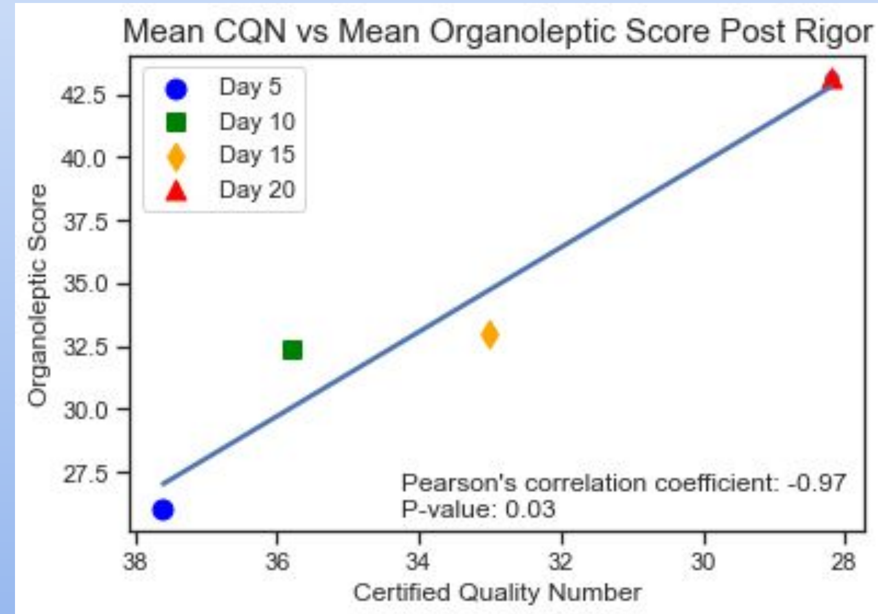
Exploring the Uses of Bioelectrical Impedance Analysis to Quantify Organoleptic Sensory Data in Farm-Raised Olive Flounder, *Paralichthys olivaceus*

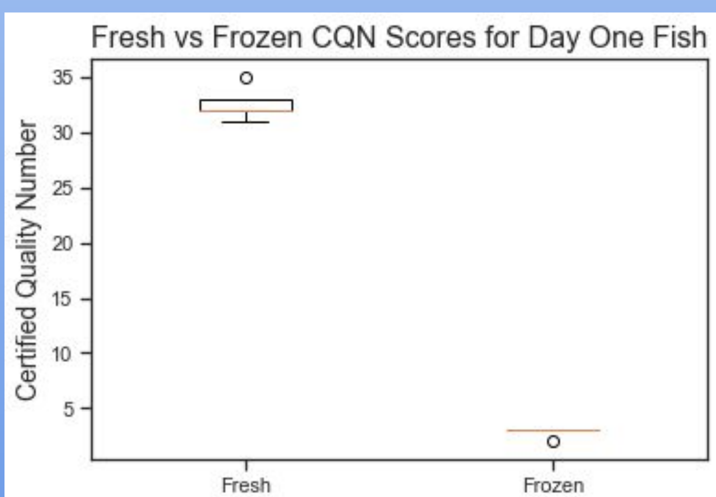
Jack Colman[1*], Scott Zimmerman[2], Ronald H. Hoenig[1], John D. Stieglitz[1]
[1]University of Miami - Rosenstiel School of Marine, Atmospheric, and Earth Science; Miami, FL
[2]Safe Quality Seafood Associates, LLC (SQSA); Miami, FL
*E-mail: jxc2165@miami.edu

UNIVERSITY OF MIAMI ROSENSTIEL SCHOOL of MARINE, ATMOSPHERIC & EARTH SCIENCE

AQUACULTURE

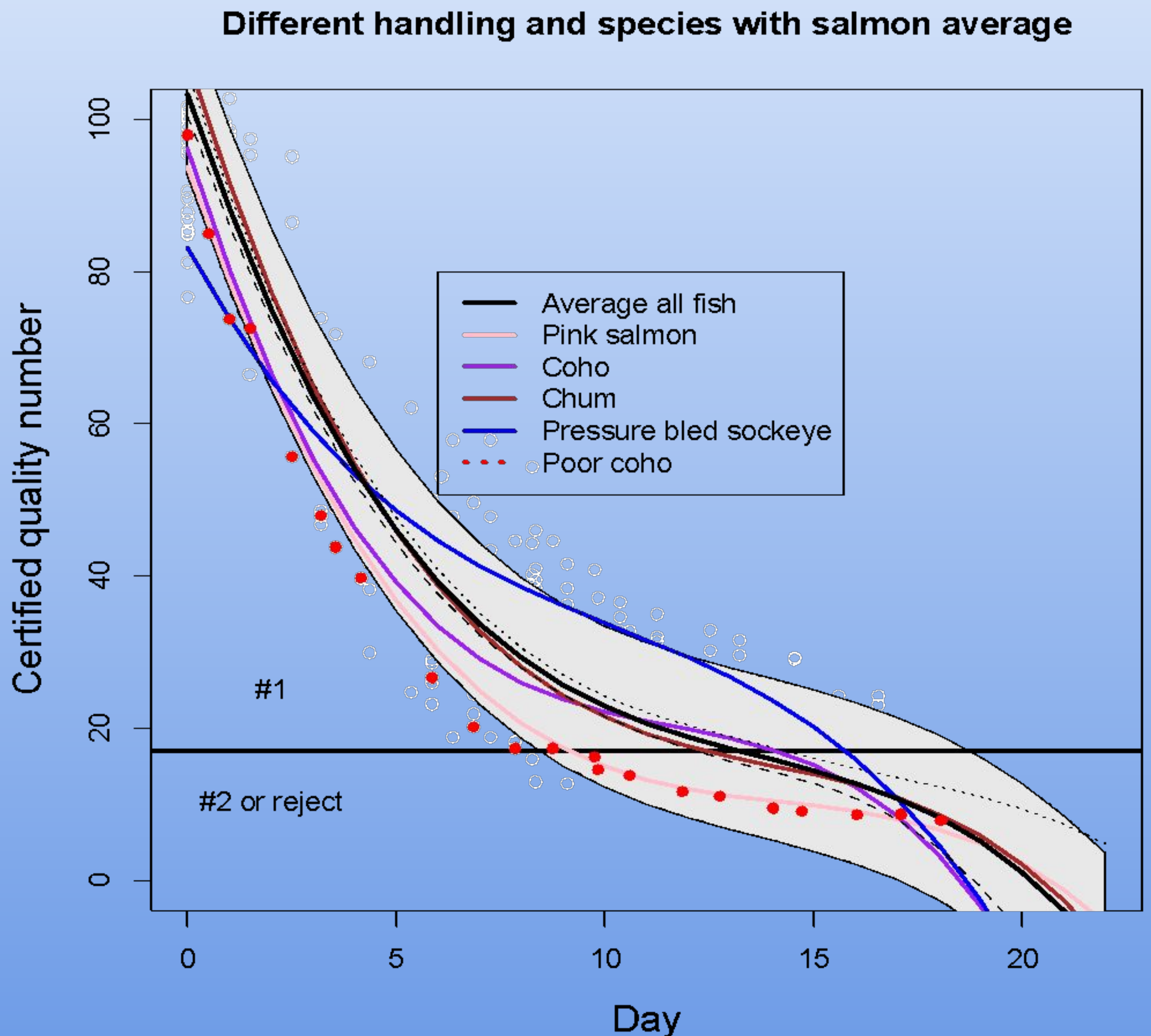






- Quality
- Grade
- Time since harvest
- Shelf life remaining
- Frozen or not

Degradation and quality

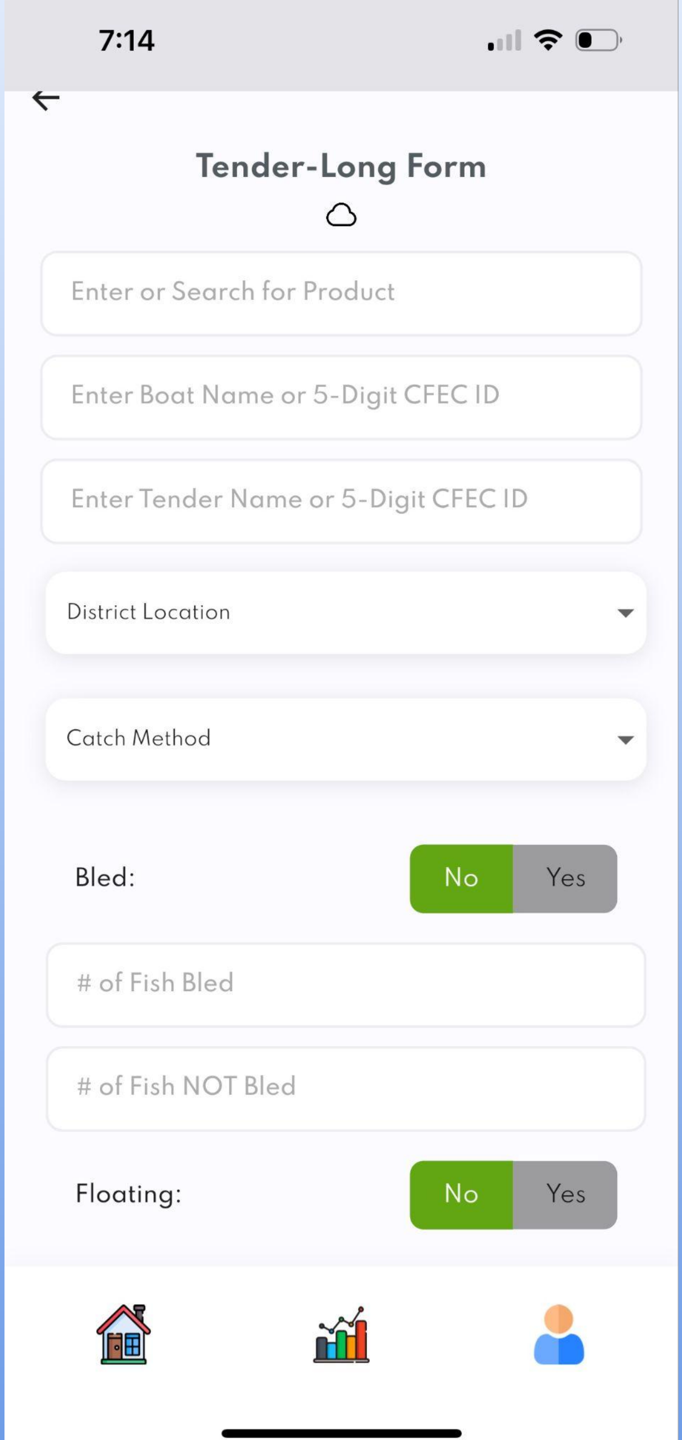


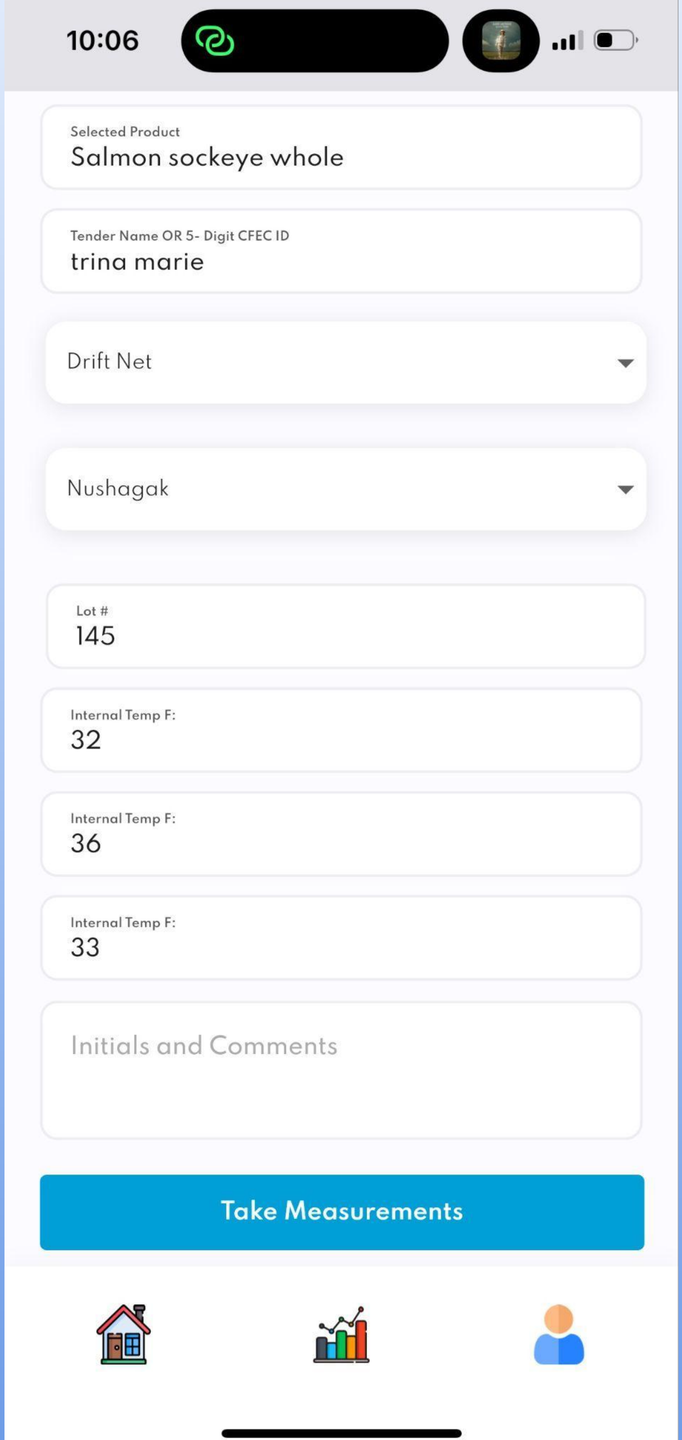
Needs of the customer to use bioimpedance

Near real time

Device and driver

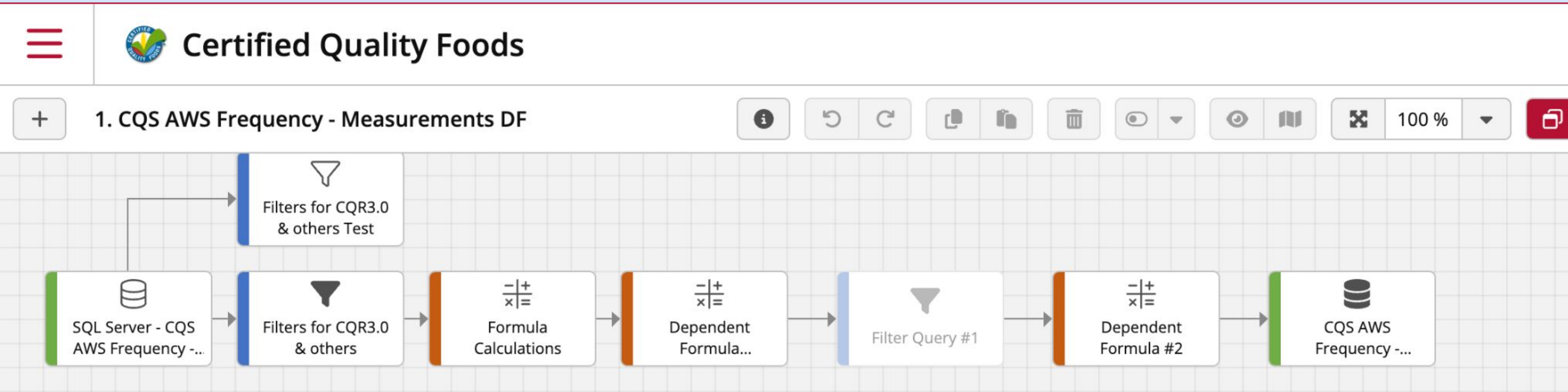
Better functionality
Smaller
Multiple frequency
Inexpensive

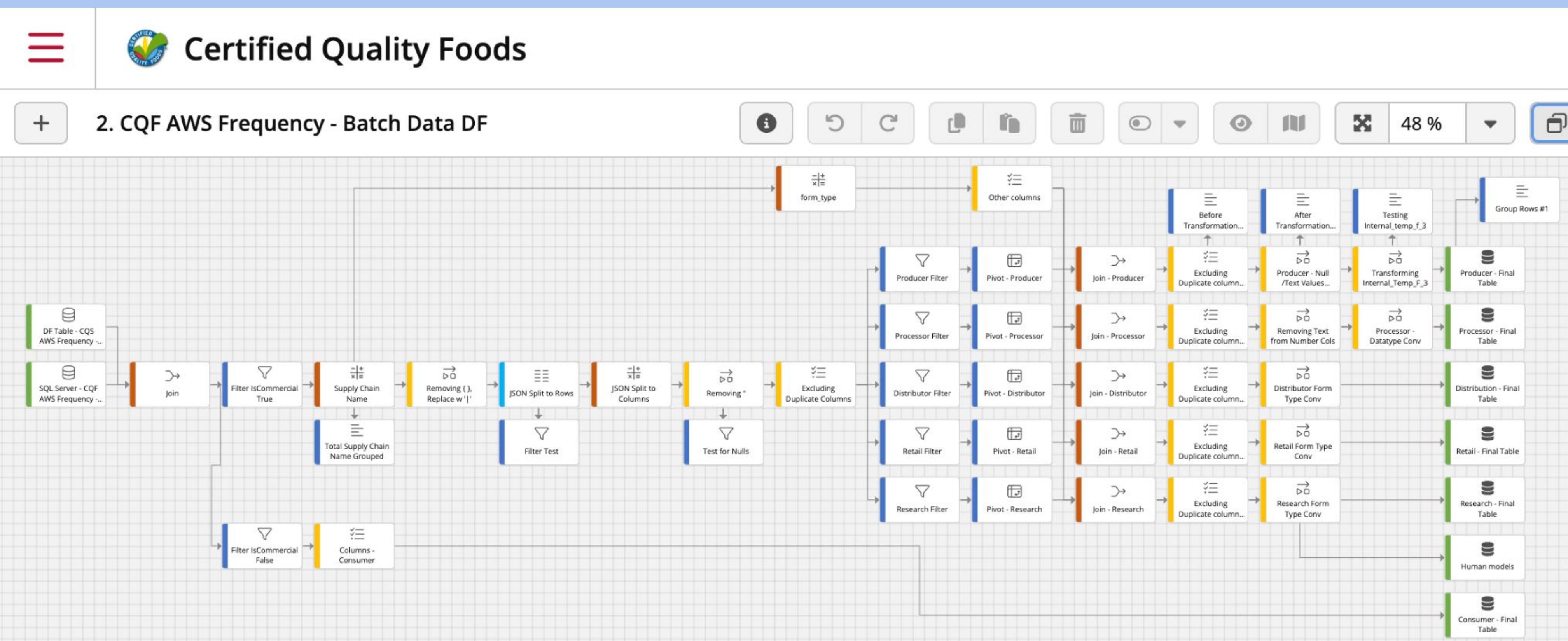


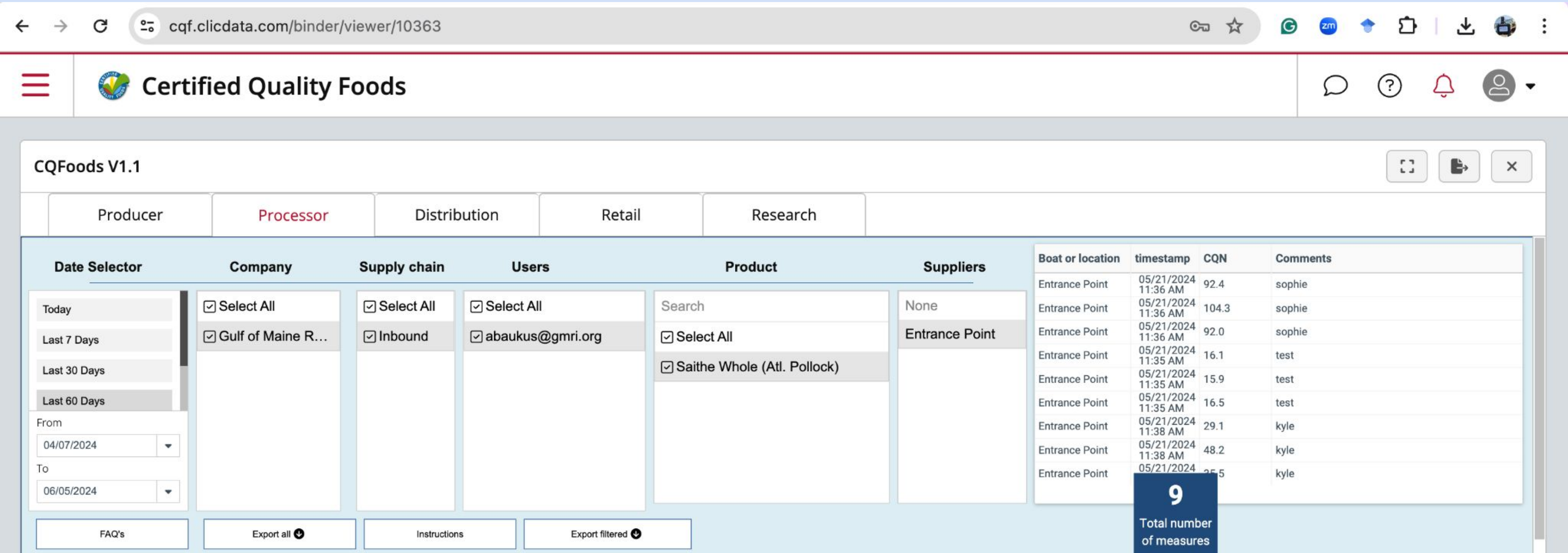


Forms on Fire

Database


Certified Quality Foods
1. CQS AWS Frequency - Measurements DF
100 %
Filters for CQR3.0 & others Test
SQL Server - CQS AWS Frequency -...
Filters for CQR3.0 & others
Formula Calculations
Dependent Formula...
Filter Query #1
Dependent Formula #2
CQS AWS Frequency -...

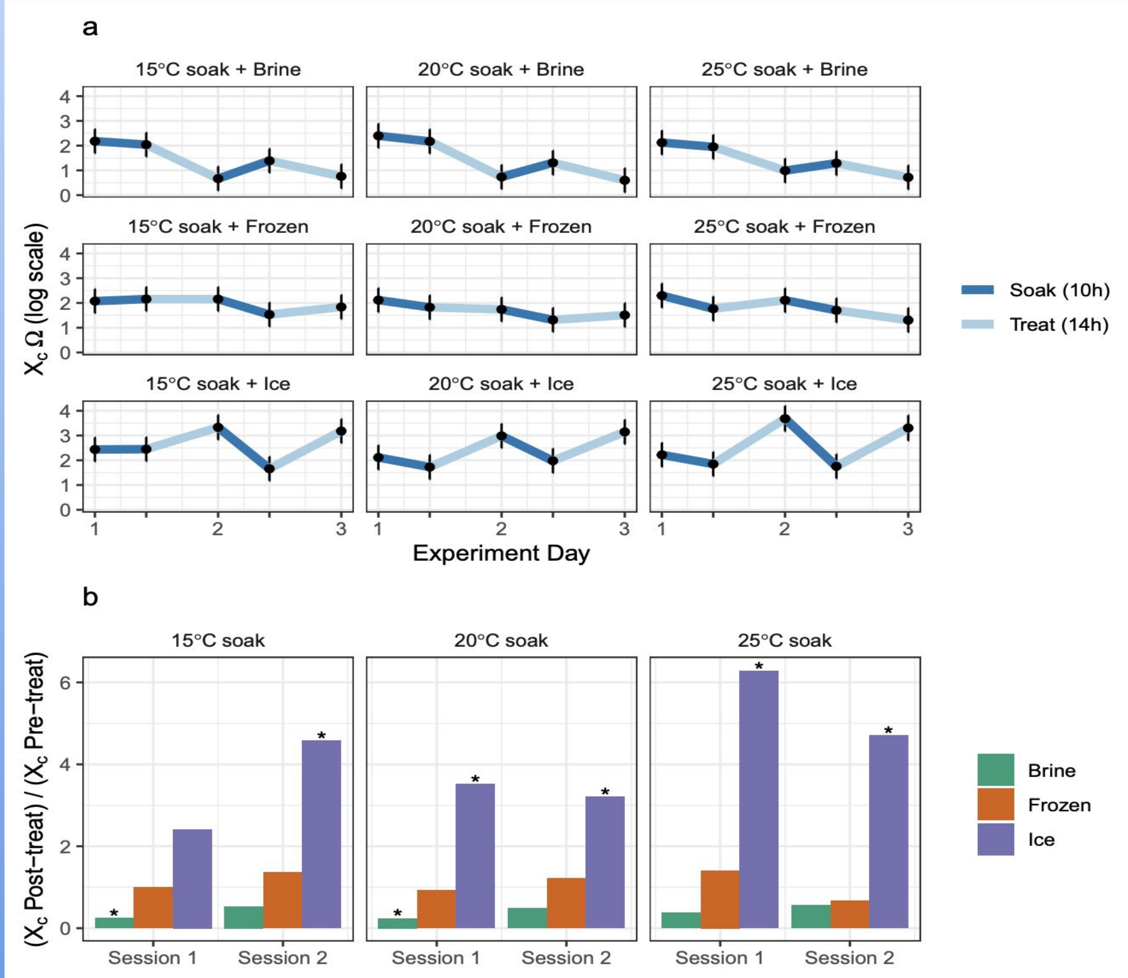

Certified Quality Foods
2. CQF AWS Frequency - Batch Data DF
48 %
form_type
Other columns
Before Transformation...
After Transformation...
Testing Internal_temp_f_3
Group Rows #1
Producer Filter
Pivot - Producer
Join - Producer
Excluding Duplicate column...
Producer - Null /Text Values...
Transforming Internal_Temp_F_3
Producer - Final Table
DF Table - CQS AWS Frequency -...
Processor Filter
Pivot - Processor
Join - Processor
Removing Text from Number Cols
Processor - Datatype Conv
Processor - Final Table
SQL Server - CQF AWS Frequency -...
Join
Filter IsCommercial True
Supply Chain Name
Removing { }, Replace w '|'
JSON Split to Rows
JSON Split to Columns
Removing "
Excluding Duplicate Columns
Distributor Filter
Pivot - Distributor
Join - Distributor
Distributor Form Type Conv
Distribution - Final Table
Total Supply Chain Name Grouped
Filter Test
Test for Nulls
Retail Filter
Pivot - Retail
Join - Retail
Retail Form Type Conv
Retail - Final Table
Research Filter
Pivot - Research
Join - Research
Research Form Type Conv
Research - Final Table
Human models
Filter IsCommercial False
Columns - Consumer
Consumer - Final Table

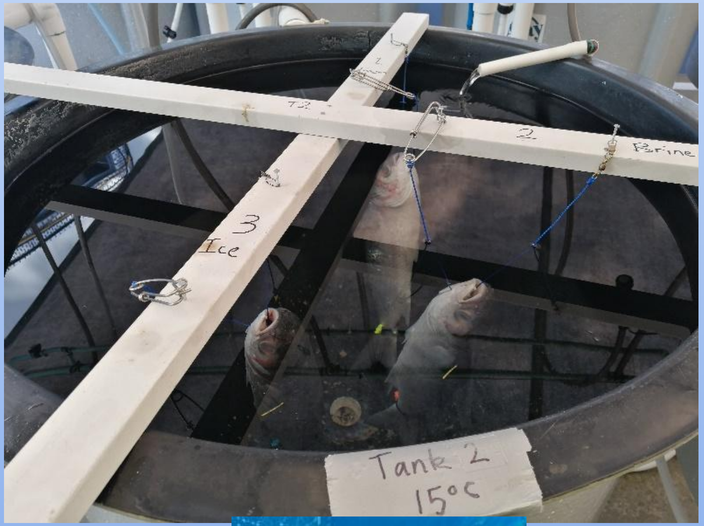

cqf.clicdata.com/binder/viewer/10363
Certified Quality Foods
CQFoods V1.1
Producer
Processor
Distribution
Retail
Research
Date Selector
Company
Supply chain
Users
Product
Suppliers
Today
Last 7 Days
Last 30 Days
Last 60 Days
From
04/07/2024
To
06/05/2024
Select All
Gulf of Maine R…
Select All
Inbound
Select All
abaukus@gmri.org
Search
Select All
Saithe Whole (Atl. Pollock)
None
Entrance Point
Boat or location
timestamp
CQN
Comments
Entrance Point 05/21/2024 11:36 AM 92.4 sophie
Entrance Point 05/21/2024 11:36 AM 104.3 sophie
Entrance Point 05/21/2024 11:36 AM 92.0 sophie
Entrance Point 05/21/2024 11:35 AM 16.1 test
Entrance Point 05/21/2024 11:35 AM 15.9 test
Entrance Point 05/21/2024 11:35 AM 16.5 test
Entrance Point 05/21/2024 11:38 AM 29.1 kyle
Entrance Point 05/21/2024 11:38 AM 48.2 kyle
Entrance Point 05/21/2024 kyle
9
Total number of measures
FAQ's
Export all
Instructions
Export filtered

Assessing the potential of bait reuse in a large-scale SMART drumline program

Craig Bell 1 , Paul A. Butcher 1,2 , Keith Cox 3 , ,2, Stephen Morris 4 , and Brendan Kelaher 1
1 National Marine Science Centre, Faculty of Science and Engineering, Southern Cross University, PO Box 4321, Coffs Harbour, NSW, 2450, Australia
2 NSW Department of Primary Industries, National Marine Science Centre, Coffs Harbour, NSW 2450, Australia
3 National Marine Fisheries Service, Alaska Fisheries Science Center, Auke Bay Laboratories 11305 Glacier Hwy Juneau, Alaska 99801
4 NSW Department of Primary Industries, Wollongbar, NSW 2477, Australia

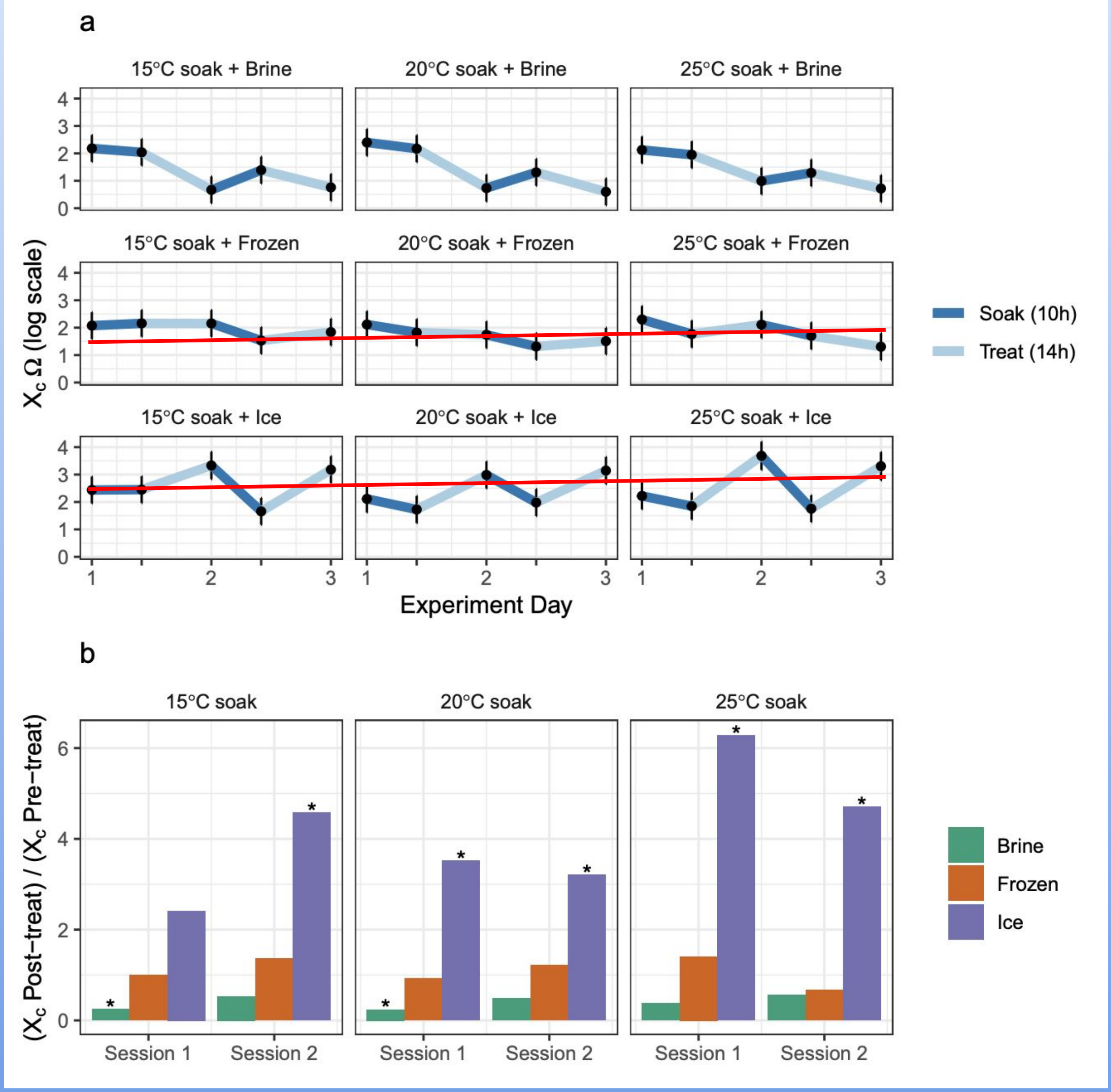
Southern Cross University





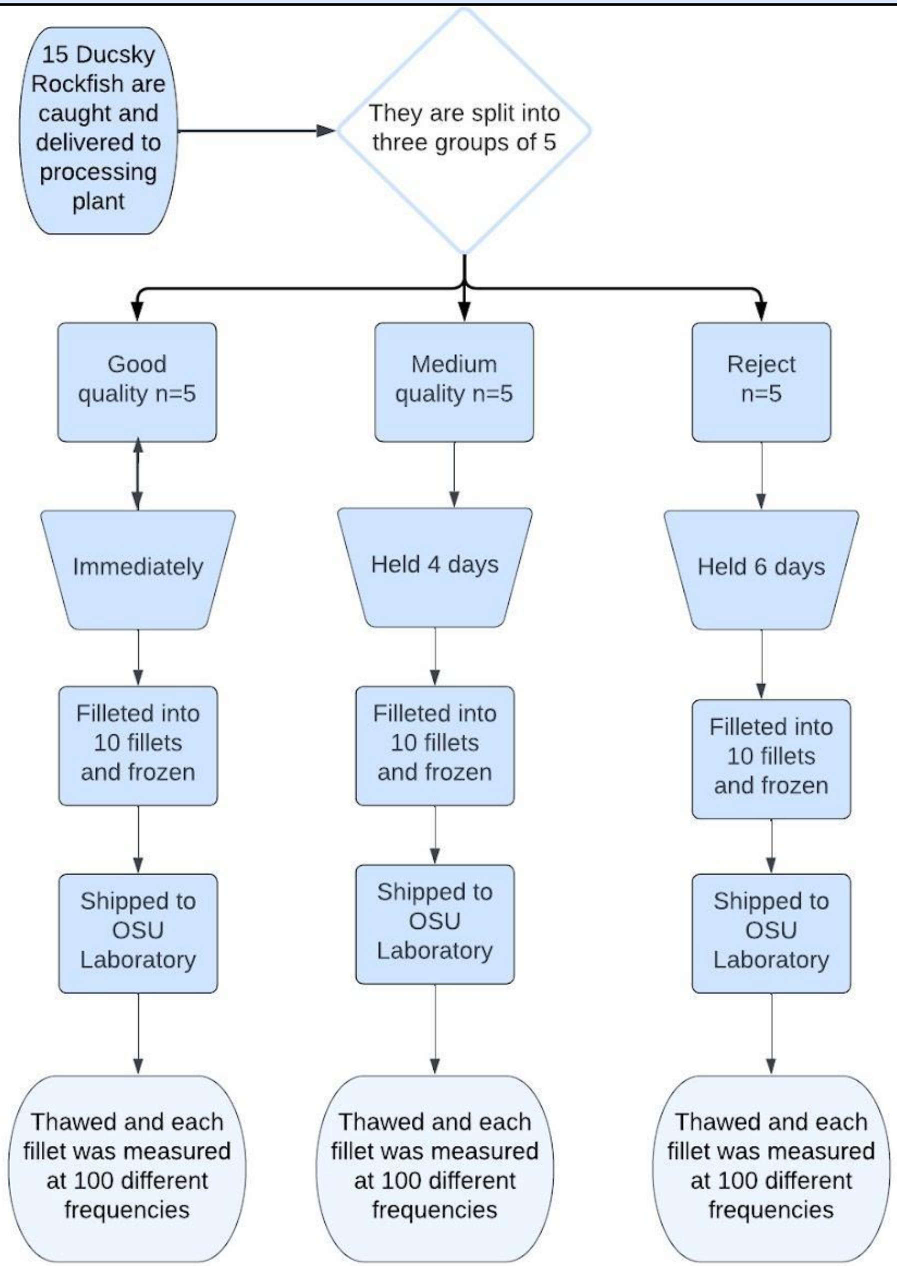
Assessing the potential of bait reuse in a large-scale SMART drumline program

Southern Cross University



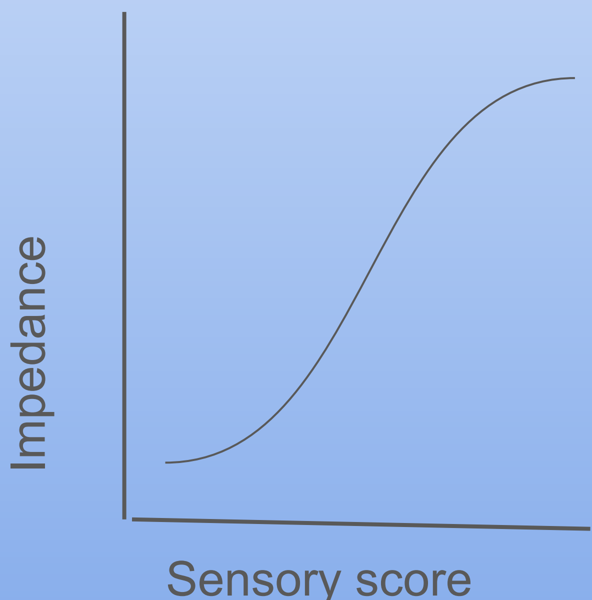
- Ice and freezing worked best
- Different equations were tested
- Brining was the worst

Quality of previously frozen fish



Bioimpedance Predictive Models for Sensory Scores on Previously Frozen Finfish

Keith Cox - CQ Foods, Juneau AK
Christina Dewitt - Oregon State University, Astoria OR
Paul Koenig - Oregon State University, Astoria OR
Jesse Trushenski - Riverence, Rodchester WA



CheckPoint1 10:59 AM

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116.597023	161.003891	116.597023	309.0910339
125.9015884	90.83753204	125.9015884	305.1504822
135.9486694	58.92863083	135.9486694	337.5605774
146.7975159	81.81140137	146.7975159	-1.337897182
158.5121002	96.53781128	158.5121002	-9.711104393
171.1615295	82.99285126	171.1615295	-15.62839794
184.8204041	73.68148041	184.8204041	-5.896260262
199.5692596	84.03646851	199.5692596	-1.981430531
215.4950867	82.84349823	215.4950867	-6.08878994
232.6918182	77.76433563	232.6918182	-2.769347429
251.2608643	83.27751923	251.2608643	-1.391065478
271.3117371	79.85466766	271.3117371	-3.025654554
292.9627075	80.56131744	292.9627075	-1.163848281
316.3414307	81.07154083	316.3414307	-2.128114223
341.5857849	81.40858459	341.5857849	-0.4355385005
368.844696	80.25855255	368.844696	-1.121836901
398.2788696	81.3033905	398.2788696	-0.8472059965
430.0619507	80.43151093	430.0619507	-0.2315688282
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Measurement Pa	Body Impedance	
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Points	100	
Amplitude	600	mVpp
Enable	1	
Stop Frequency	200000	Hz
Logarithmic	1	
Power Mode	Low Power	
Transimpedance	16	pF
Sample Rate	10	sps
Internal RTIA Sel	1K	Ω
Calibration Resis	10000	Ω
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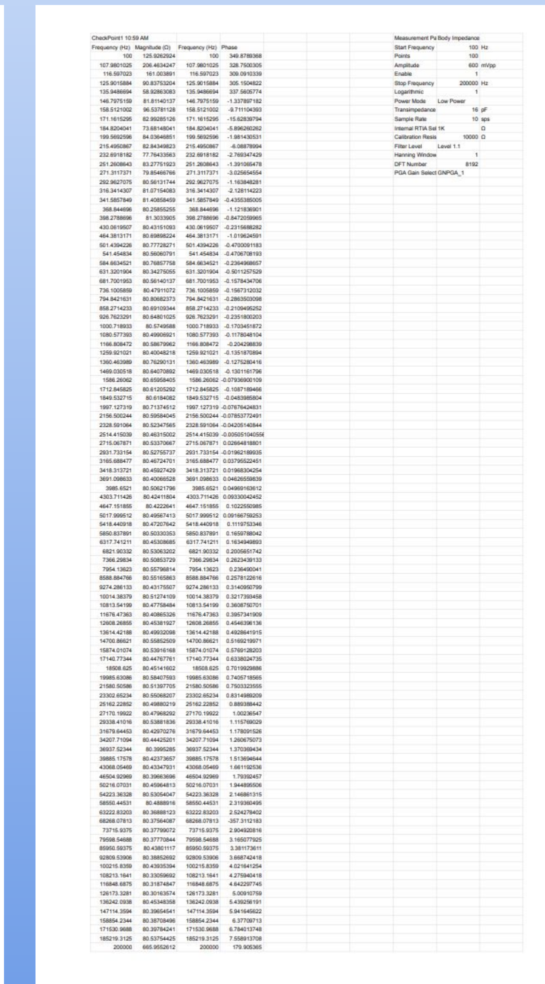

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232.6918182	77.76433563	232.6918182	-2.769347429
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2931.733154	80.52755737	2931.733154	-0.01962189935
3165.688477	80.46724701	3165.688477	0.03795522451
3418.313721	80.45927429	3418.313721	0.01968304254
3691.098633	80.40066528	3691.098633	0.04626559839
3985.6521	80.50621796	3985.6521	0.04969163612
4303.711426	80.42411804	4303.711426	0.09330042452
4647.151855	80.4222641	4647.151855	0.1022550985
5017.999512	80.49567413	5017.999512	0.09166759253
5418.440918	80.47207642	5418.440918	0.1119753346
5850.837891	80.50330353	5850.837891	0.1659788042
6317.741211	80.45308685	6317.741211	0.1634949893
6821.90332	80.53063202	6821.90332	0.2005651742
7366.29834	80.50853729	7366.29834	0.2623439133
7954.13623	80.55796814	7954.13623	0.236490041
8588.884766	80.55165863	8588.884766	0.2578122616
9274.286133	80.43175507	9274.286133	0.3140950799
10014.38379	80.51274109	10014.38379	0.3217393458
10813.54199	80.47758484	10813.54199	0.3608750701
11676.47363	80.40865326	11676.47363	0.3957341909
12608.26855	80.45381927	12608.26855	0.4546396136
13614.42188	80.49932098	13614.42188	0.4928641915
14700.86621	80.55852509	14700.86621	0.5169219971
15874.01074	80.53916168	15874.01074	0.5769128203
17140.77344	80.44767761	17140.77344	0.6338024735
18508.625	80.45141602	18508.625	0.7019929886
19985.63086	80.58407593	19985.63086	0.7405718565
21580.50586	80.51397705	21580.50586	0.7503323555
23302.65234	80.55068207	23302.65234	0.8314989209
25162.22852	80.49880219	25162.22852	0.889388442
27170.19922	80.47968292	27170.19922	1.00236547
29338.41016	80.53881836	29338.41016	1.115769029
31679.64453	80.42970276	31679.64453	1.178091526
34207.71094	80.44425201	34207.71094	1.260675073
36937.52344	80.3995285	36937.52344	1.370369434
39885.17578	80.42373657	39885.17578	1.513694644
43068.05469	80.43347931	43068.05469	1.661192536
46504.92969	80.39663696	46504.92969	1.79392457
50216.07031	80.45964813	50216.07031	1.944895506
54223.36328	80.53054047	54223.36328	2.146861315
58550.44531	80.4888916	58550.44531	2.319360495
63222.83203	80.36888123	63222.83203	2.524278402
68268.07813	80.37564087	68268.07813	-357.3112183
73715.9375	80.37799072	73715.9375	2.904920816
79598.54688	80.37770844	79598.54688	3.165077925
85950.59375	80.43801117	85950.59375	3.381173611
92809.53906	80.38852692	92809.53906	3.668742418
100215.8359	80.43935394	100215.8359	4.021641254
108213.1641	80.33059692	108213.1641	4.275940418
116848.6875	80.31874847	116848.6875	4.642297745
126173.3281	80.30163574	126173.3281	5.00910759
136242.0938	80.45348358	136242.0938	5.439256191
147114.3594	80.39654541	147114.3594	5.941645622
158854.2344	80.38708496	158854.2344	6.37709713
171530.9688	80.39784241	171530.9688	6.784013748
185219.3125	80.53754425	185219.3125	7.558913708
200000	665.9552612	200000	179.905365

Measurement Pa	Body Impedance	
Start Frequency	100	Hz
Points	100	
Amplitude	600	mVpp
Enable	1	
Stop Frequency	200000	Hz
Logarithmic	1	
Power Mode	Low Power	
Transimpedance	16	pF
Sample Rate	10	sps
Internal RTIA Sel	1K	Ω
Calibration Resis	10000	Ω
Filter Level	Level 1.1	
Hanning Window	1	
DFT Number	8192	
PGA Gain Select	GNPGA_1	

Bioimpedance Predictive Models for Sensory Scores on Previously Frozen Finfish

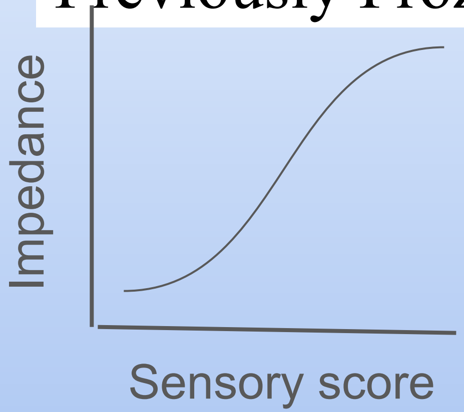
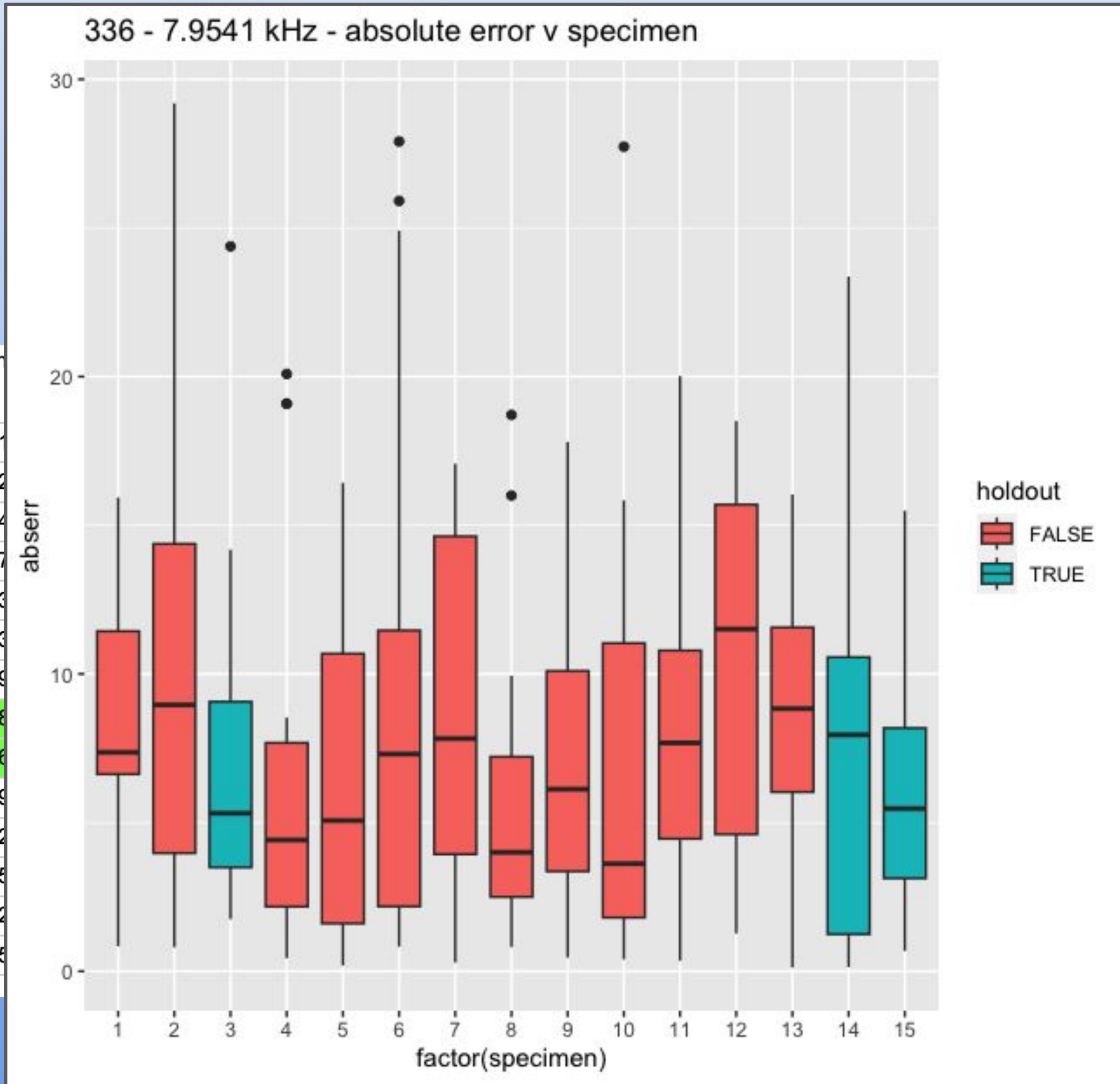


Table 4. Total frequencies that were scanned. Green
from Wilcoxen comparisons (p=0.1).

0.13	0.14	0.15	0.1
0.22	0.23	0.25	0.2
0.37	0.40	0.43	0.4
0.63	0.68	0.74	0.7
1.08	1.17	1.26	1.3
1.85	2.00	2.16	2.3
3.17	3.42	3.69	3.9
5.42	5.85	6.32	6.8
9.27	10.01	10.81	11.6
15.87	17.14	18.51	19.9
27.17	29.34	31.68	34.2
46.50	50.22	54.22	58.5
79.60	85.95	92.81	100.2
136.24	147.11	158.85	171.5

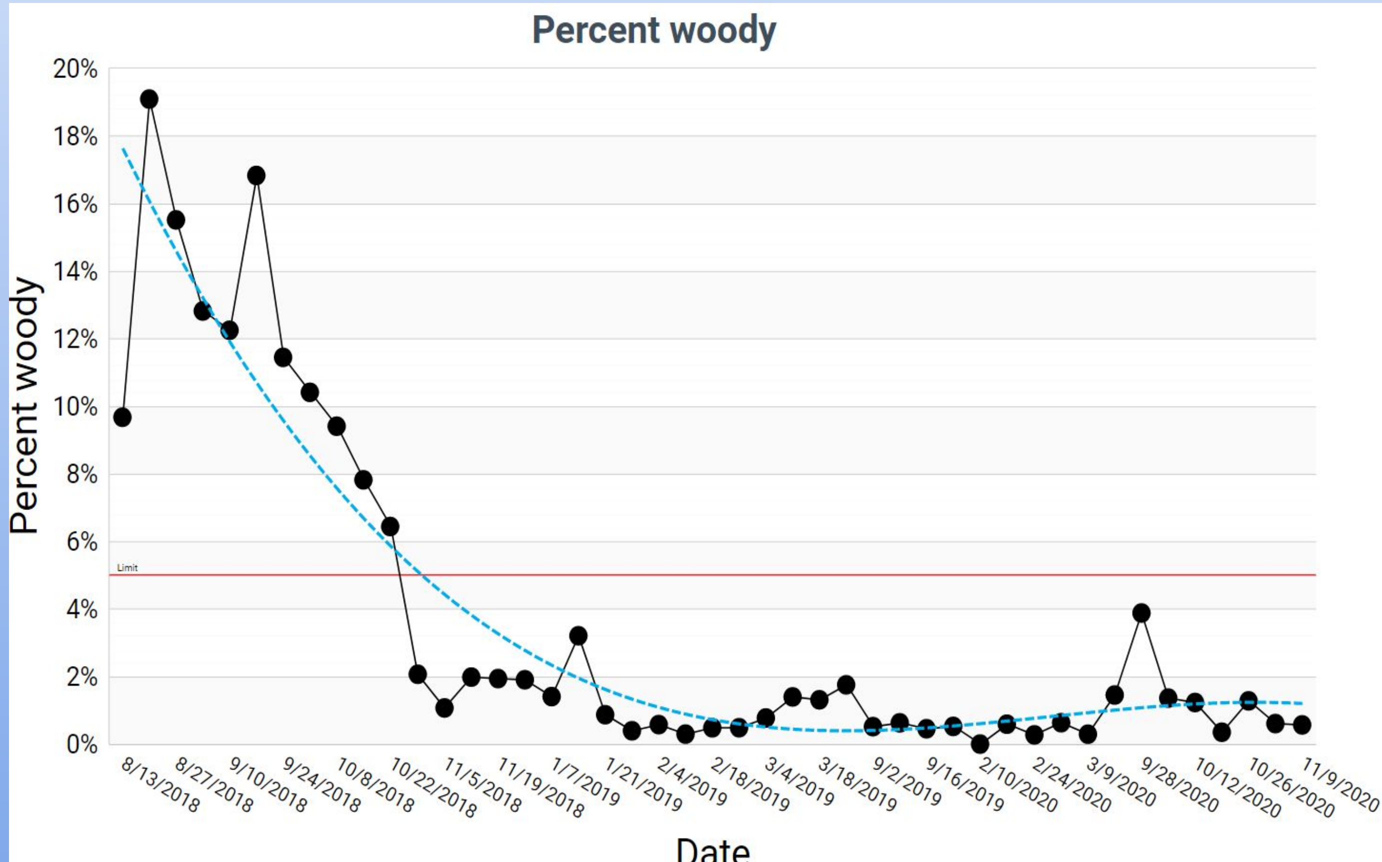


Application of Bioelectrical Impedance Analysis to Detect Broiler Breast Filets Affected With Woody Breast Myopathy

Amit Morey[1], Avery E. Smith[1], Laura Jewell Garner[1] and Marlin K. Cox[2]*

AUBURN UNIVERSITY

FIGURE 1 | Bioelectrical impedance analysis of whole breast filet.

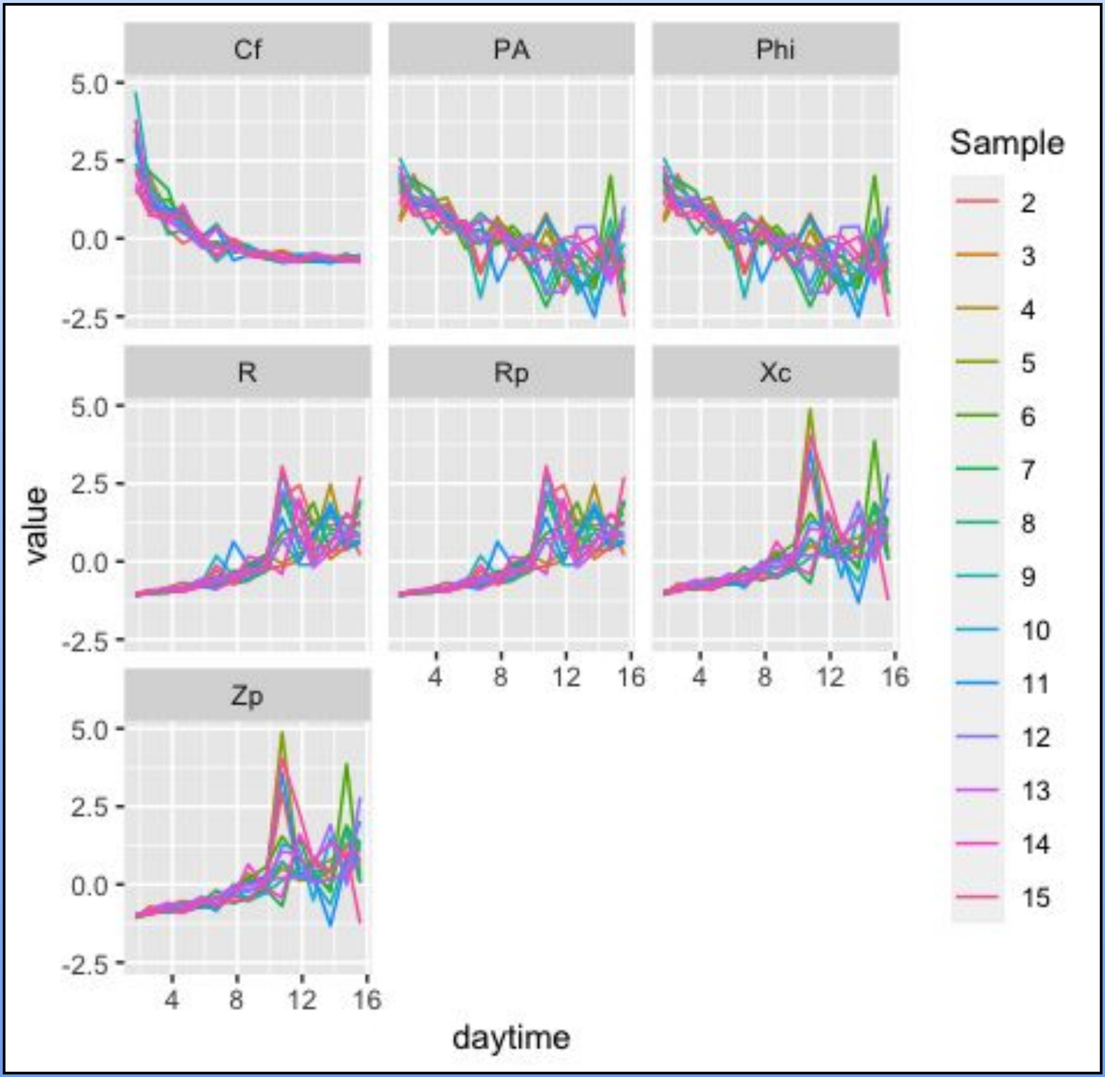


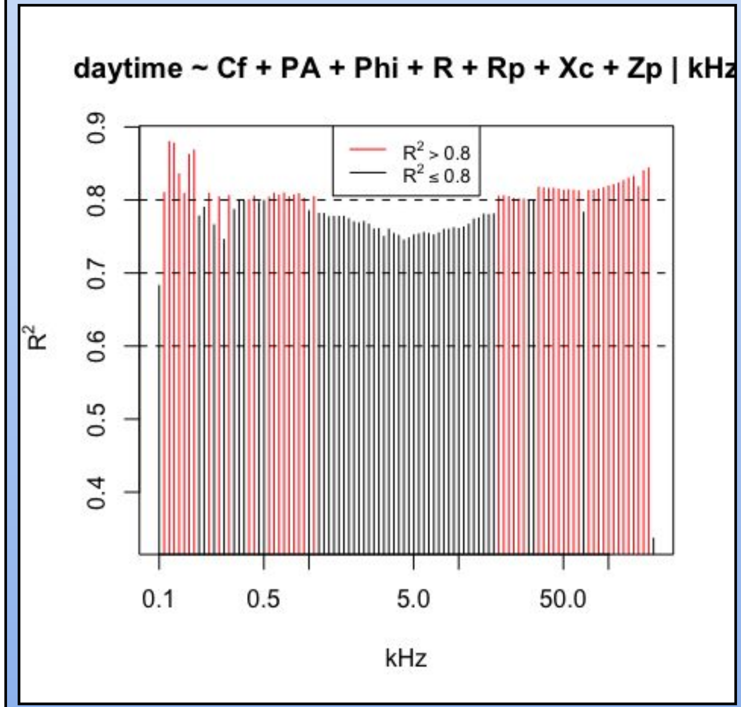
Measuring Shrimp

Quality and Previously Frozen

Measuring Degradation of Previously Frozen Shrimp.

Darryl Holiday, Holy Cross University
Keith Cox , CQ Foods

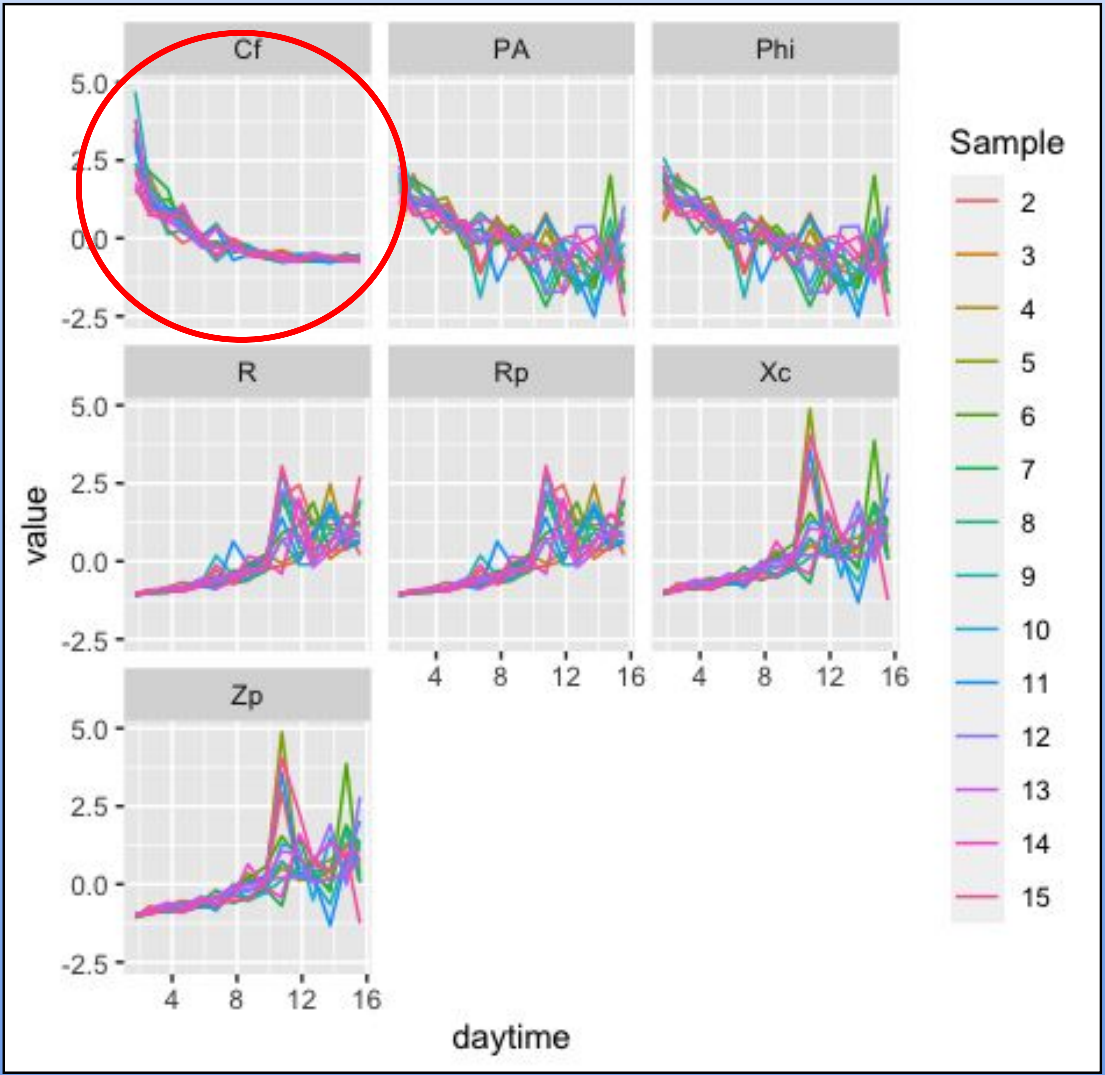


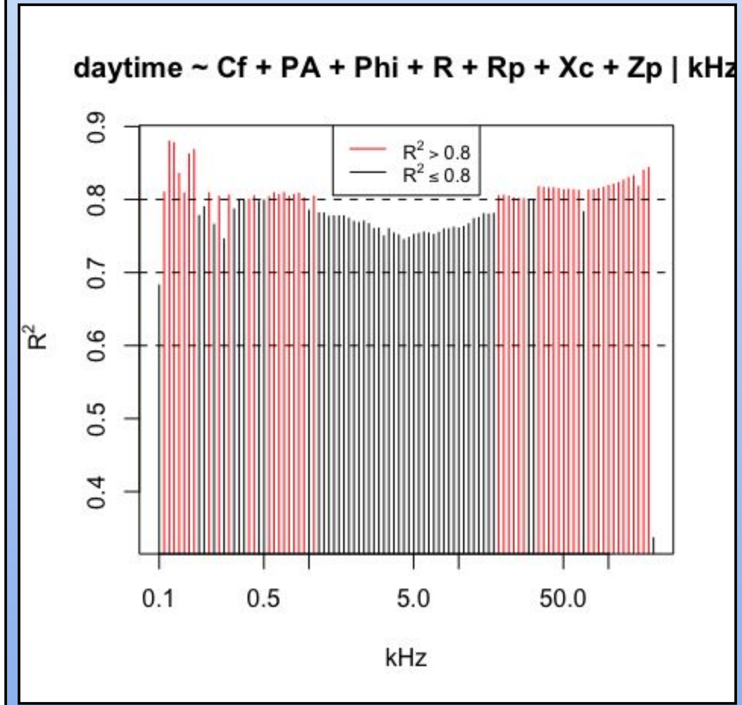


- Higher frequency and Cf was best predictor
- Shell on did not work at any frequency

Measuring Degradation of Previously Frozen Shrimp.

Darryl Holiday, Holy Cross University
Keith Cox , CQ Foods





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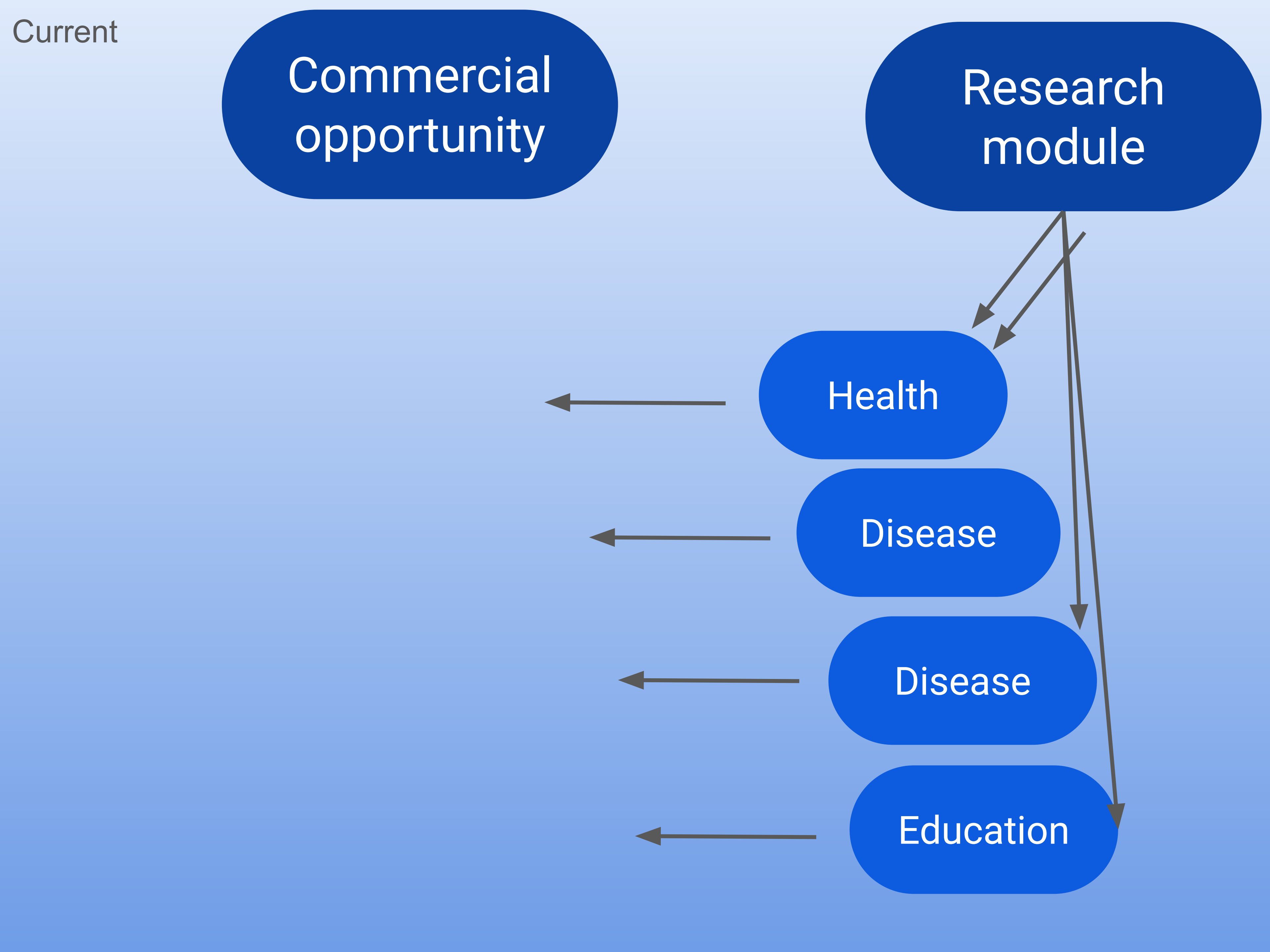

Current
Commercial opportunity
Research module
Health
Disease
Disease
Education