

Socioeconomic and Wellbeing Outcomes under Catch Shares: A Case Study of the LAGC IFQ Program

September 2025

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Don Schug

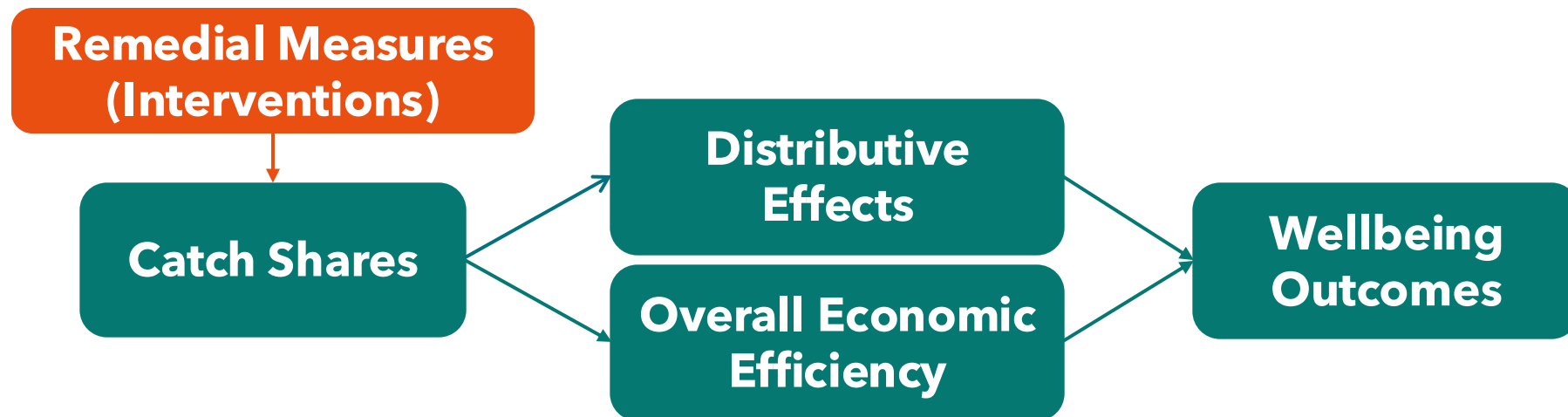
Kanae Tokunaga, Ph.D.
Katherine Maltby, Ph.D.
Ben Cotton



Can catch shares better foster wellbeing?

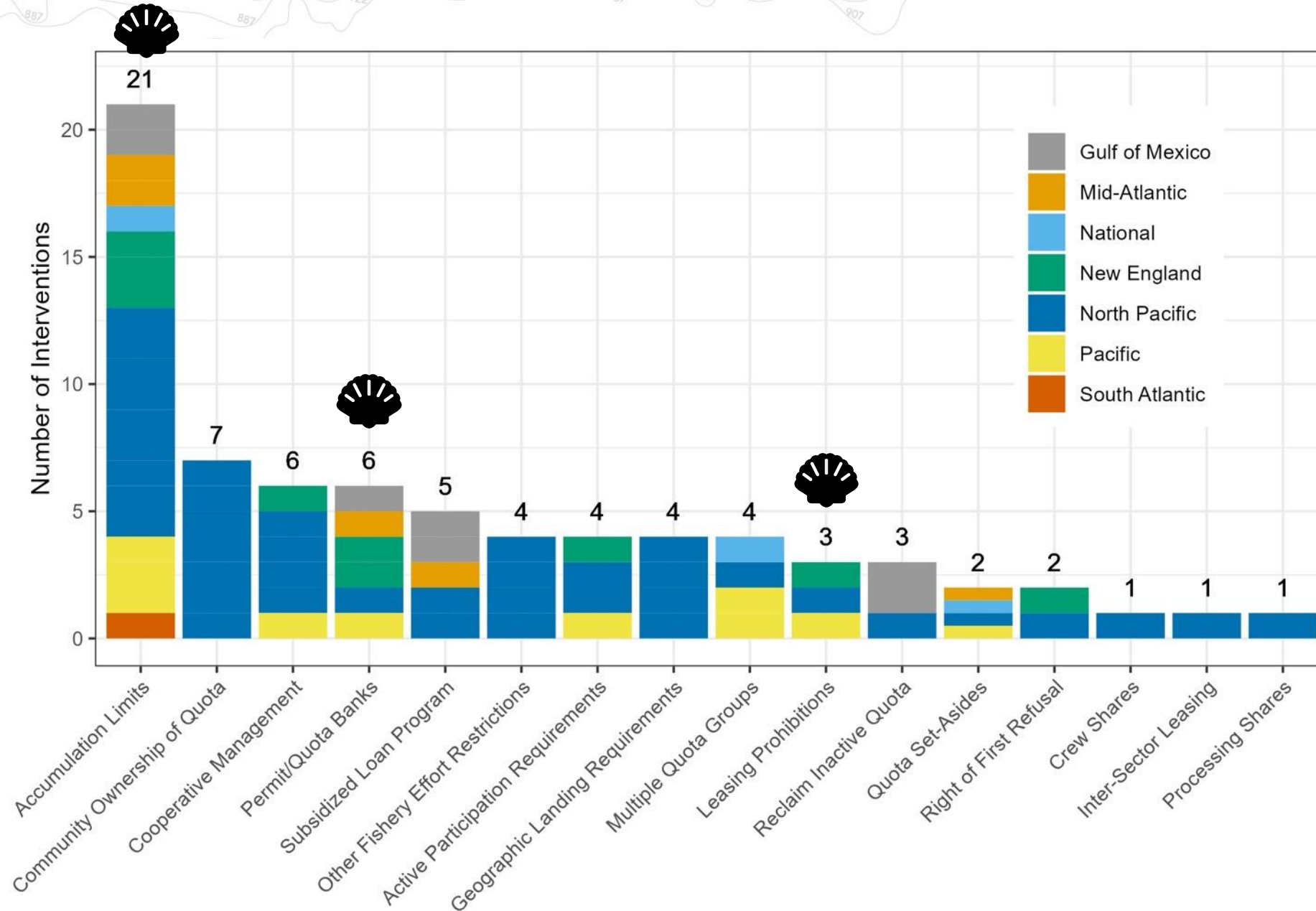
- Catch shares are known to create differential economic and social impacts on individuals and fishing communities
- Extant catch share programs have attempted to balance social outcomes with economic ones
- But questions remain about possible improvements and effects

Our conceptualization (analytical framework)



1. Develop an analytical framework of catch share interventions and outcomes
2. Examine this framework with a case study approach using interviews and empirical analysis
3. Synthesize findings and develop recommendations

Interventions by Type Across Regions

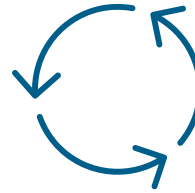


Case Study - the LAGC IFQ Scallop Program

- **Purpose:** Advance thinking on this topic through the case study, not designed to evaluate a specific policy alternative
- **Goal:** Examine tradeoffs stemming from the implementation of remedial measures designed to improve social and wellbeing outcomes in catch share programs
- LAGC IFQ Scallop Program & intervention selected based on:
 - Team member knowledge and experience
 - Expert and stakeholder feedback
 - Results of prior research and work
- Case study intervention:
 - Community ownership of quota

Interviews

- With industry associations, managers, and researchers
- Identify existing challenges and potential remedial measures



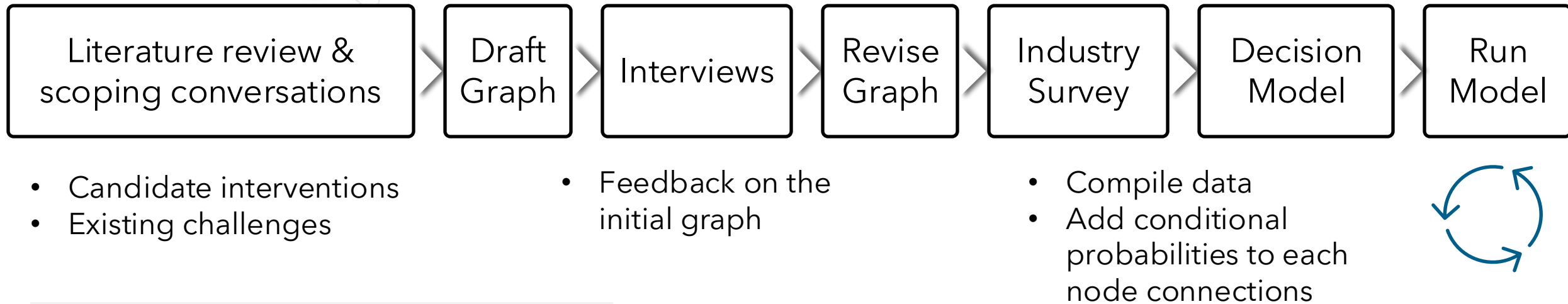
Industry phone/online survey

- Fill knowledge gap on quota ownership and leasing practices
- Gauge perceptions about the current state of various dimensions of wellbeing

Bayesian belief decision model

- Describe the system
- Explore to what extent community quota ownership can foster community wellbeing

Case study approach



Wellbeing dimensions:

- Job satisfaction
- Individual fishing reliance
- Continuity of fishing as livelihood
- Social relationships
- Management satisfaction
- Availability and affordability of quota
- Upward mobility

Industry phone/online survey

Gather information about:

- Quota access and affordability
 - Leasing decisions
 - Transfer decisions
- Wellbeing outcomes
 - Job satisfaction
 - Fishing reliance
 - Commercial fishing mobility
 - Social integrity
 - Management satisfaction
 - Quota affordability
 - Quota availability
 - Livelihood continuity

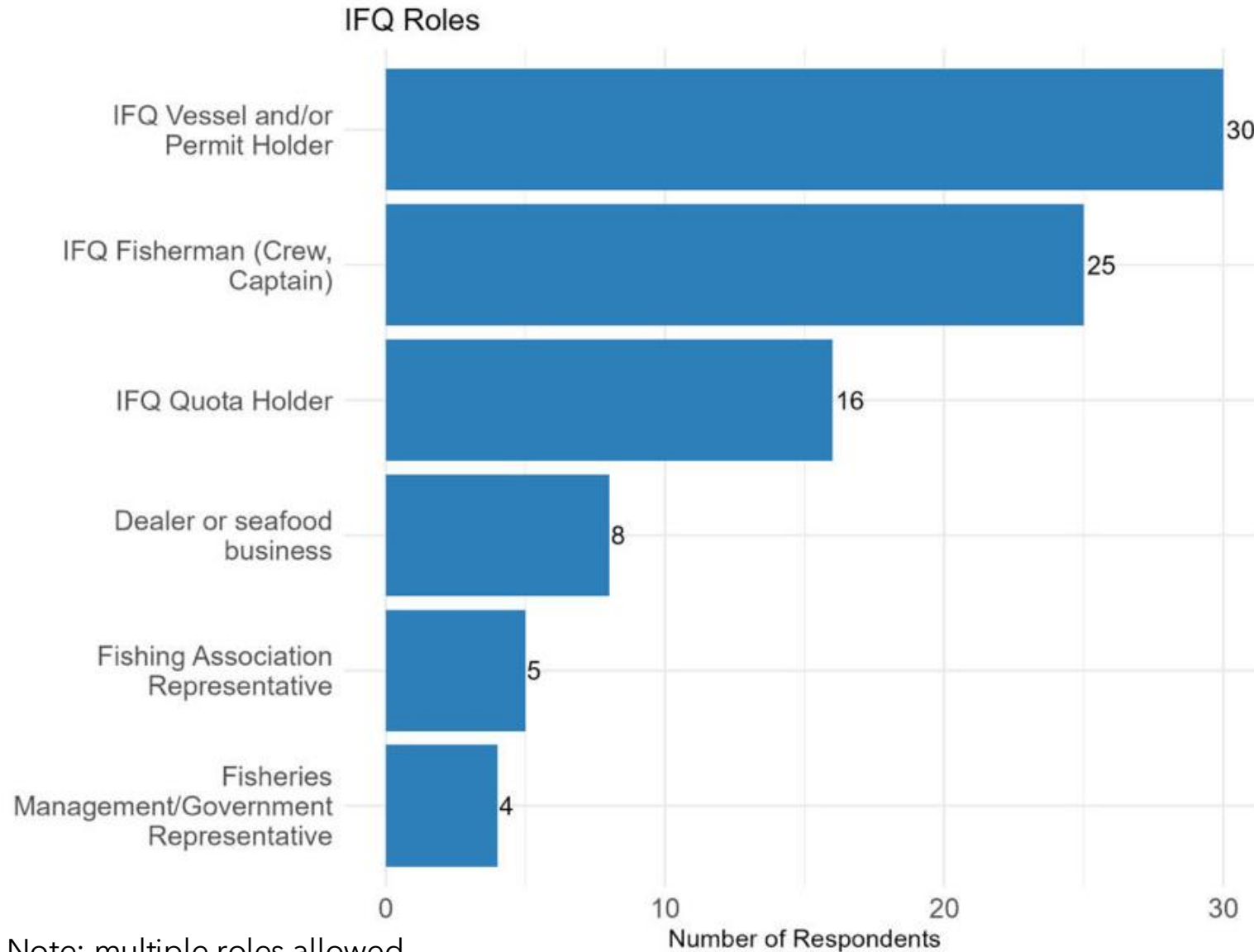
Outreach

- Maine Fishermen's Forum
- Industry Association mailing list
- Social media messaging and ads
- Phone calls to all permit holders

***Thank you to those who
contributed to this survey!!***

Total number of complete
responses = 32

Survey Respondents Roles



Note: multiple roles allowed

71%
respondents
from MA

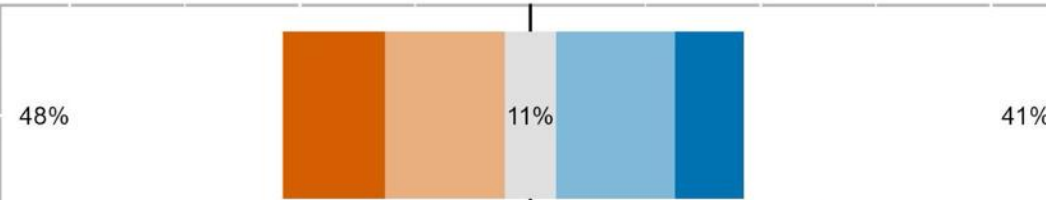
60%
Earned
> 40% of
fishery income
from IFQ

62%
No other
non-fishery
income
sources

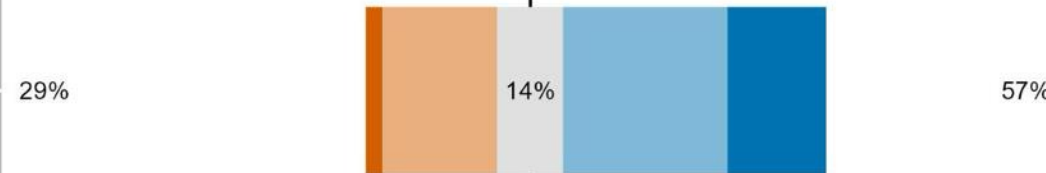
Perceptions of quota affordability

Quota Affordability Perceptions

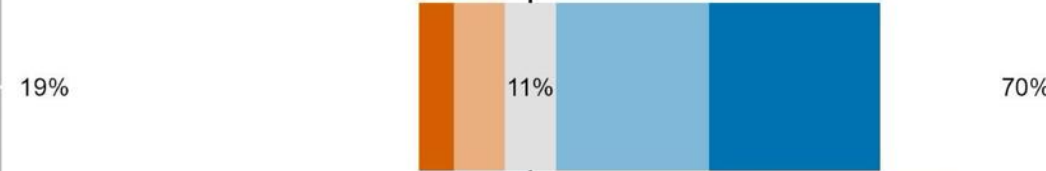
**With enough time and financial planning,
lease-dependent fishermen and new entrants can
afford to buy quota**



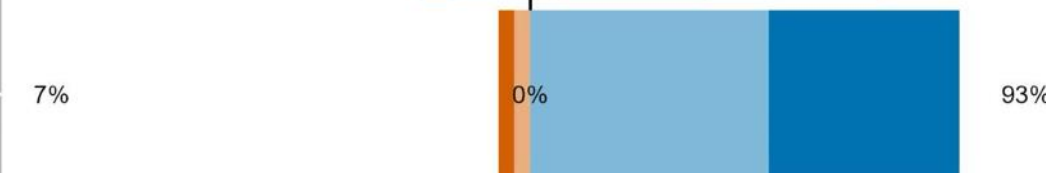
**The cost of leasing quota prevents
lease-dependent fishermen from operating
profitability**



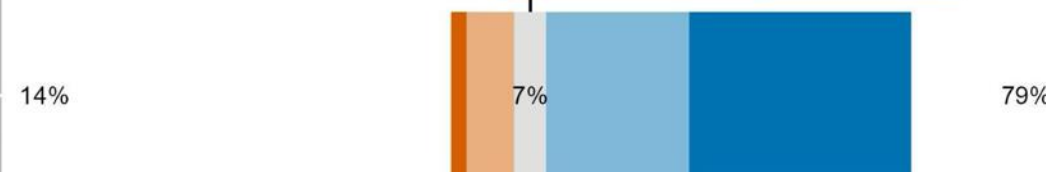
**Quota lease prices have made it harder for
fishermen to remain in the fishery**



**Compared to other operating costs, lease costs
are burdensome for lease-dependent fisherment**



**Compared to other major capital investments,
purchasing quota is financially burdensome**



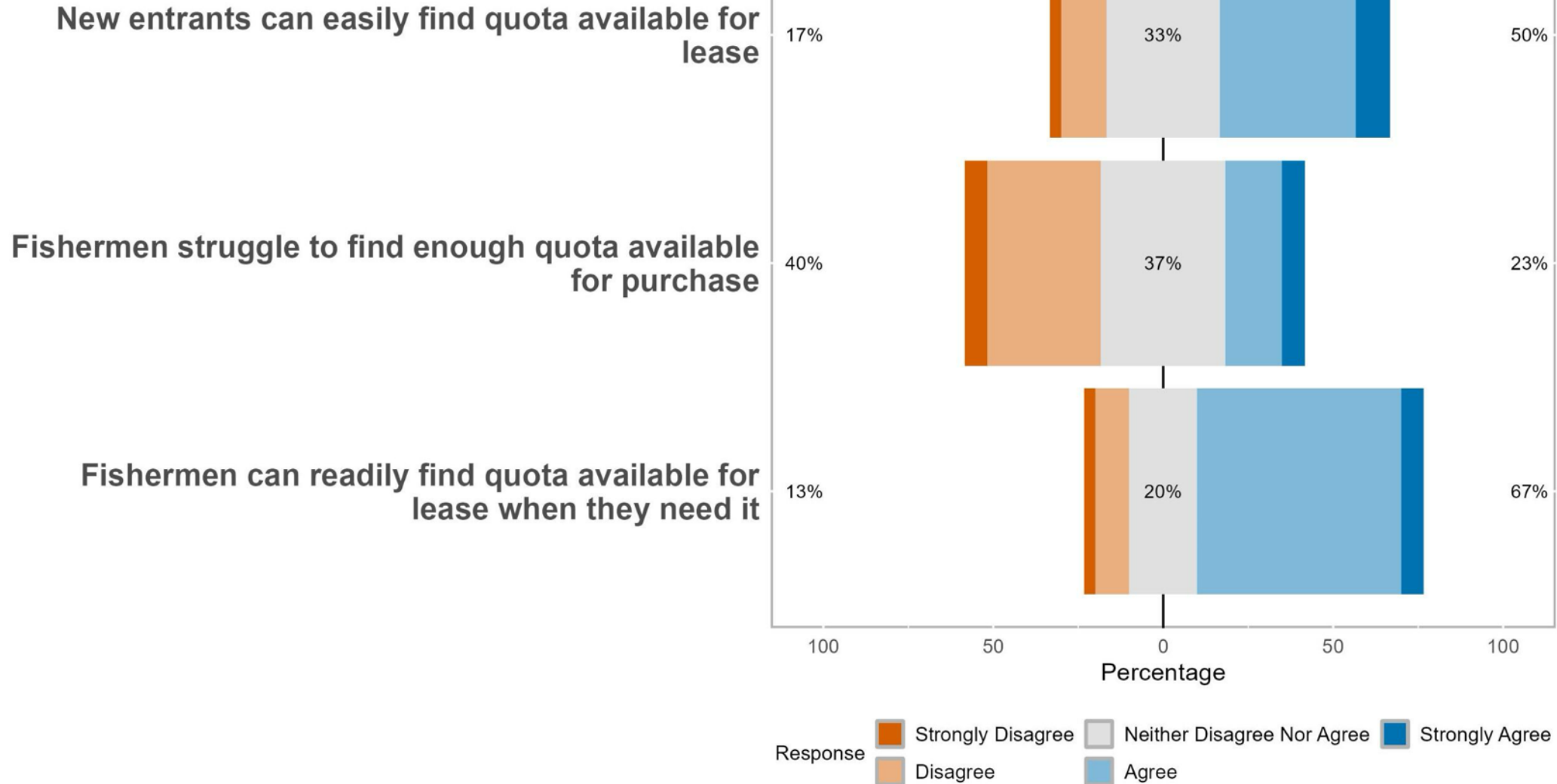
Percentage

Response

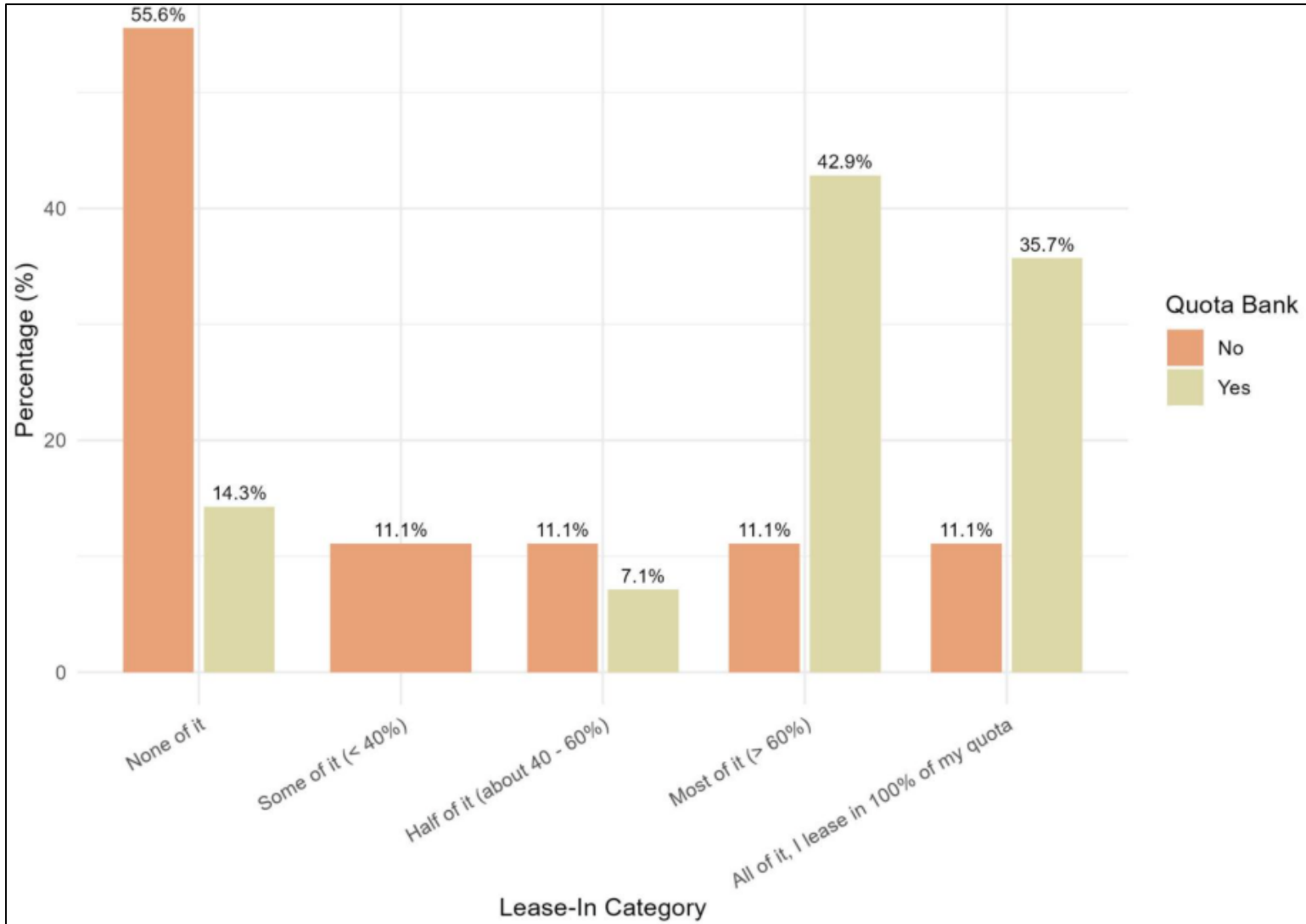
Strongly Disagree	Neither Disagree Nor Agree	Strongly Agree
Disagree	Agree	

Perceptions of quota availability

Quota Availability Perceptions



Potential for quota banks to improve quota access



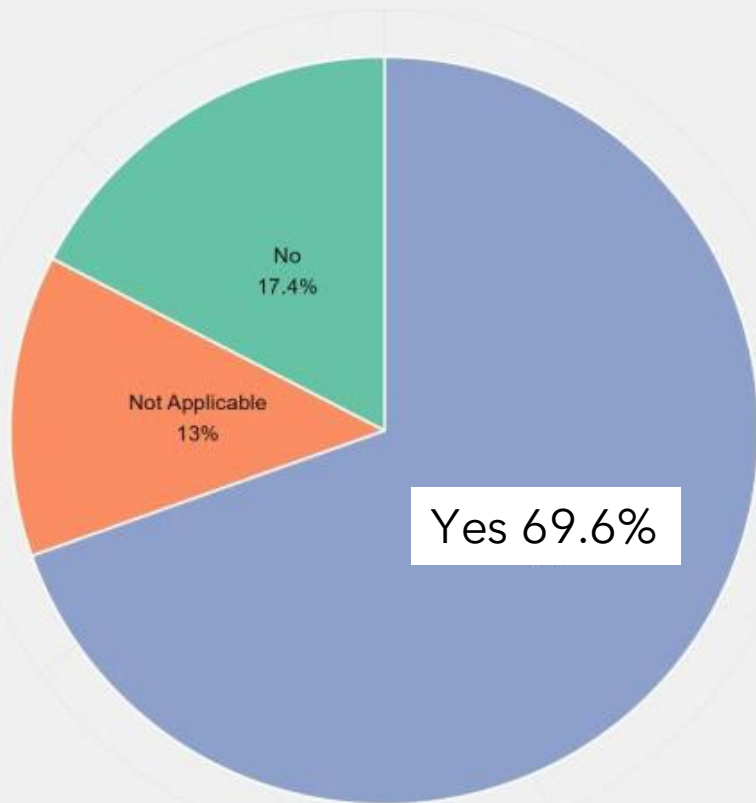
- Quota banks functionally similar to the case study intervention
- 60.8% of respondents stated to have received IFQ quota from a quota bank

Reasons noted for using a quota bank

- **Cheaper quota prices** compared to open market (note - one respondent indicated that it is more expensive to lease from a quota bank)
- To **ensure continued fishery access**
- To **ensure continued membership and voting rights**

Who's bearing the cost of quota?

Are Quota Lease Costs Deducted from the Vessel's Gross Revenue Before Crew Share is Applied?



Average Crew Pay Share (%)

45.8 %

Variance

13.71

Crew also bears the cost of quota lease

- Among those who incur lease costs, 80% answered that quota lease costs are deducted from the gross revenue before crew share is applied.

Written comments from respondents

- ***Purchasing quota is very expensive and really has to be planned for, but it's doable... Leasing in quota gets expensive as well, and has to be planned for the year previous, to know what you'll be able to catch and how much quota is around to lease.*** – Active IFQ fisherman, Massachusetts.
- ***Quota lease costs are variable to the time of year. During the last 5 years there has been a trend of highest quota lease at the beginning of the year when scallop prices begin to drop... The effect of this is that the best fishing and most effort from the IFQ fishery ... The resulting choice to the fisherman is to suffer tight margins or to fish areas and seasons that take more effort*** – Vessel owner or co-owner, Massachusetts.
- ***My son loves fishing, but I wouldn't let him get into it. Everything is too expensive and I don't see a future.*** – Vessel owner or co-owner, Massachusetts

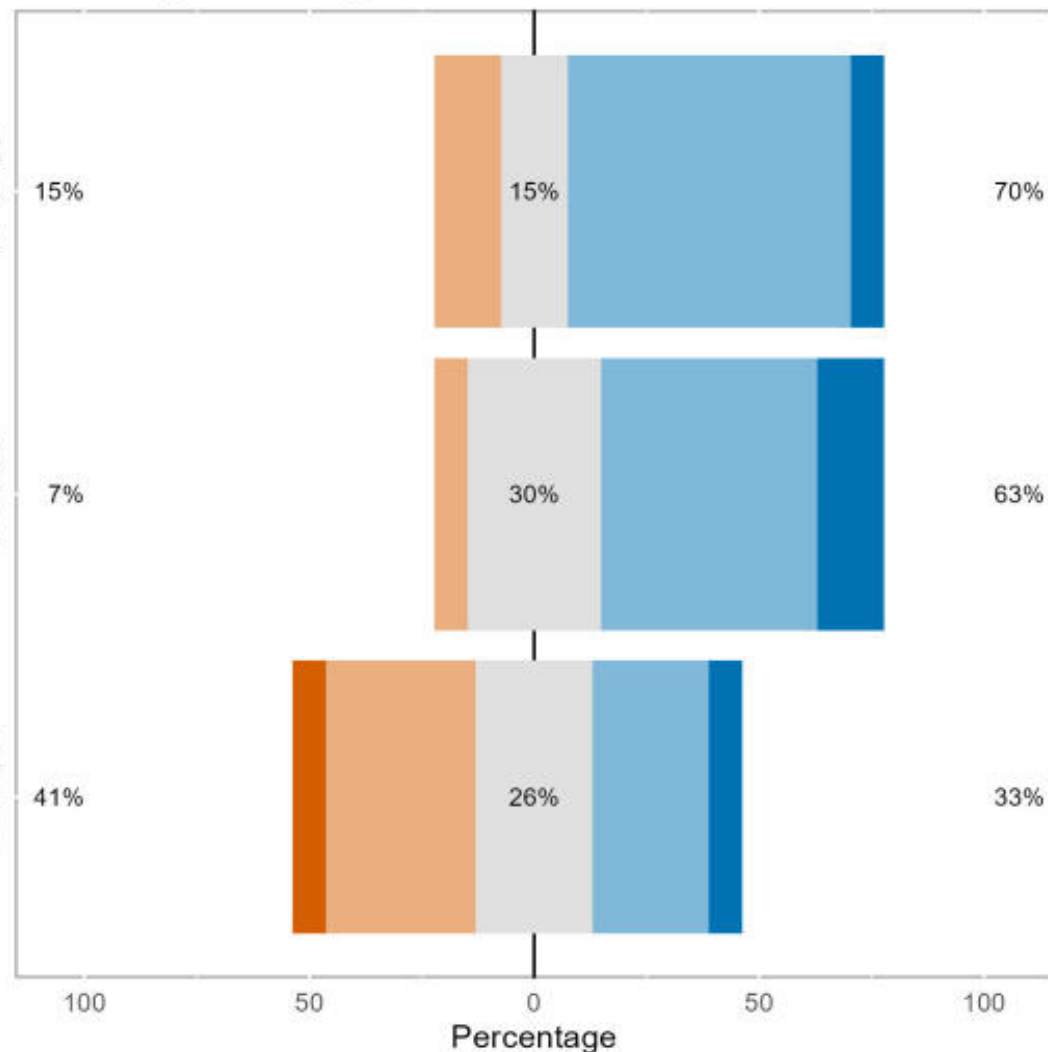
Perceptions of continuity of the scallop IFQ fishery as a livelihood into the future

Continuity of Fishing as a Livelihood

Leaving the LAGC IFQ fishery is something that fishermen are considering in my community or the communities I work with

I expect commercial fishing in the LAGC IFQ scallop fishery to be apart of the future of my community or the communities I work with

Fishermen can count on fishing in the LAGC IFQ scallop fishery as a career in my community or in the communities I work with



Response

Strongly Disagree	Neither Disagree Nor Agree	Strongly Agree
Disagree	Agree	

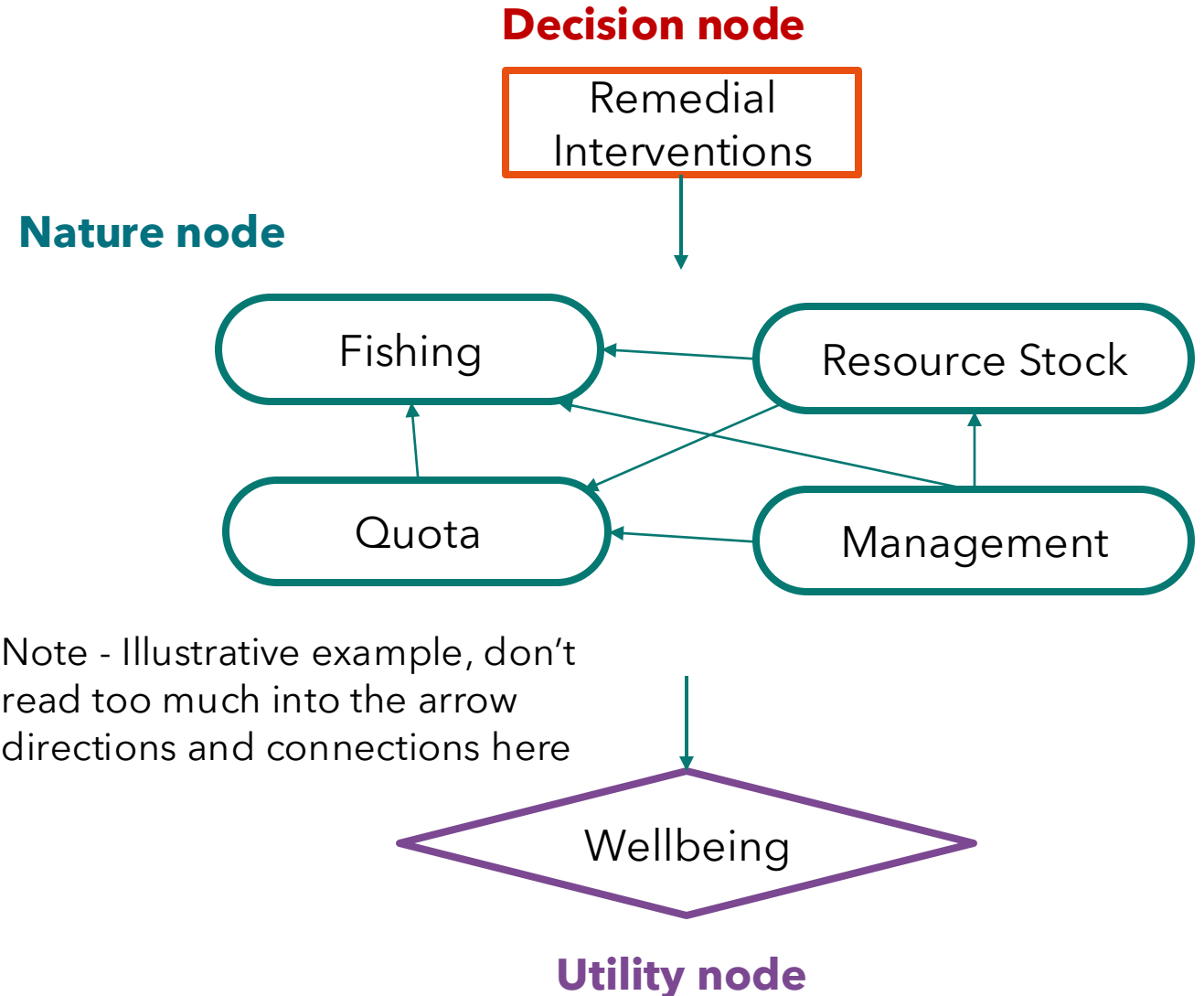
- **A number of fishers have already left the IFQ fishery. I expect some changes to come in the management of the IFQ component and am unsure if the IFQ component will remain.** Likely a hybrid model of quota rights with more controls. Or less IFQ allocation and areas that will be common pool. – Vessel owner/co-owner, Massachusetts
- It will be there, but **at what point will it no longer be worth grinding out?** [I] really don't know, fishery and market is not in a good way right now, hard to predict. [I] see boats/permits coming up for sale in the mid-Atlantic, **guys are trying to get out.** –Vessel owner/co-owner, Massachusetts
- People are **wanting to leave** because [it's] **hard to get quality help, catch [is] down and fuel \$ up**, so economically [it's] hard, have to spend more time at sea. –Vessel owner/operator, Virginia.

Bayesian Belief Decision Model

- A model that represents various components in the IFQ scallop fishery
 - Fishing, resource conditions, management, quota market, distributive effects, various wellbeing dimensions
 - Can take in multiple forms of information in varied format
 - Fairly easy to adjust and adapt as new information become available
- A model will
 - Help visualize and tease out connection across these components as understood by industry participants and experts
 - Help explore possible improvements in community wellbeing from expanding community ownership of quotas
 - Help us learn about the system and explore pathways to improve wellbeing outcomes

What is Bayesian Belief Decision Model (in a nutshell)

- Graphical model with probabilities assigned to each node connections
- Tests different decisions to see how to maximize expected utility (wellbeing) under different conditions:
 - Management intervention that maximized the wellbeing outcome
 - Expected wellbeing outcome under different decisions
- Relationships between nodes based on literature, interviews, and expert judgment



Process of developing and running the model

Literature review &
scoping conversations

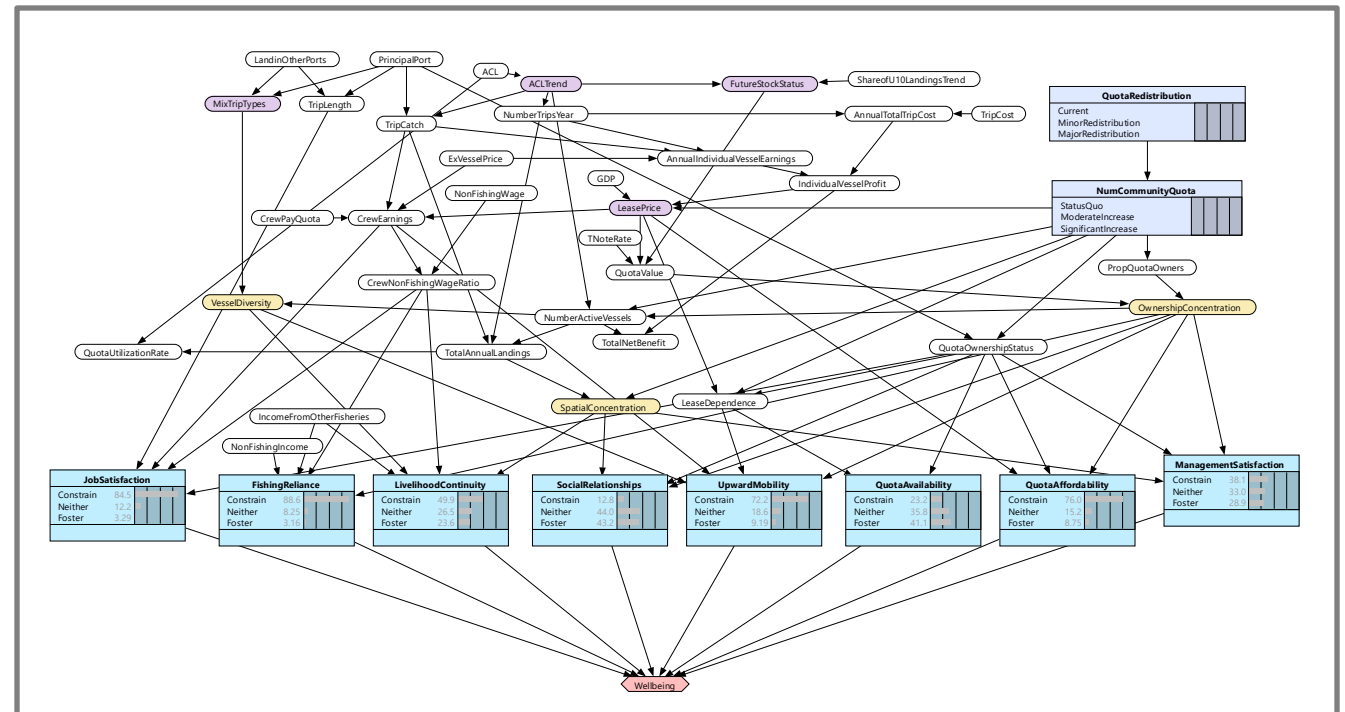
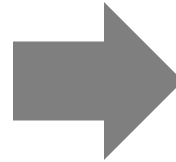
Draft
Graph

Interviews

Revise
Graph

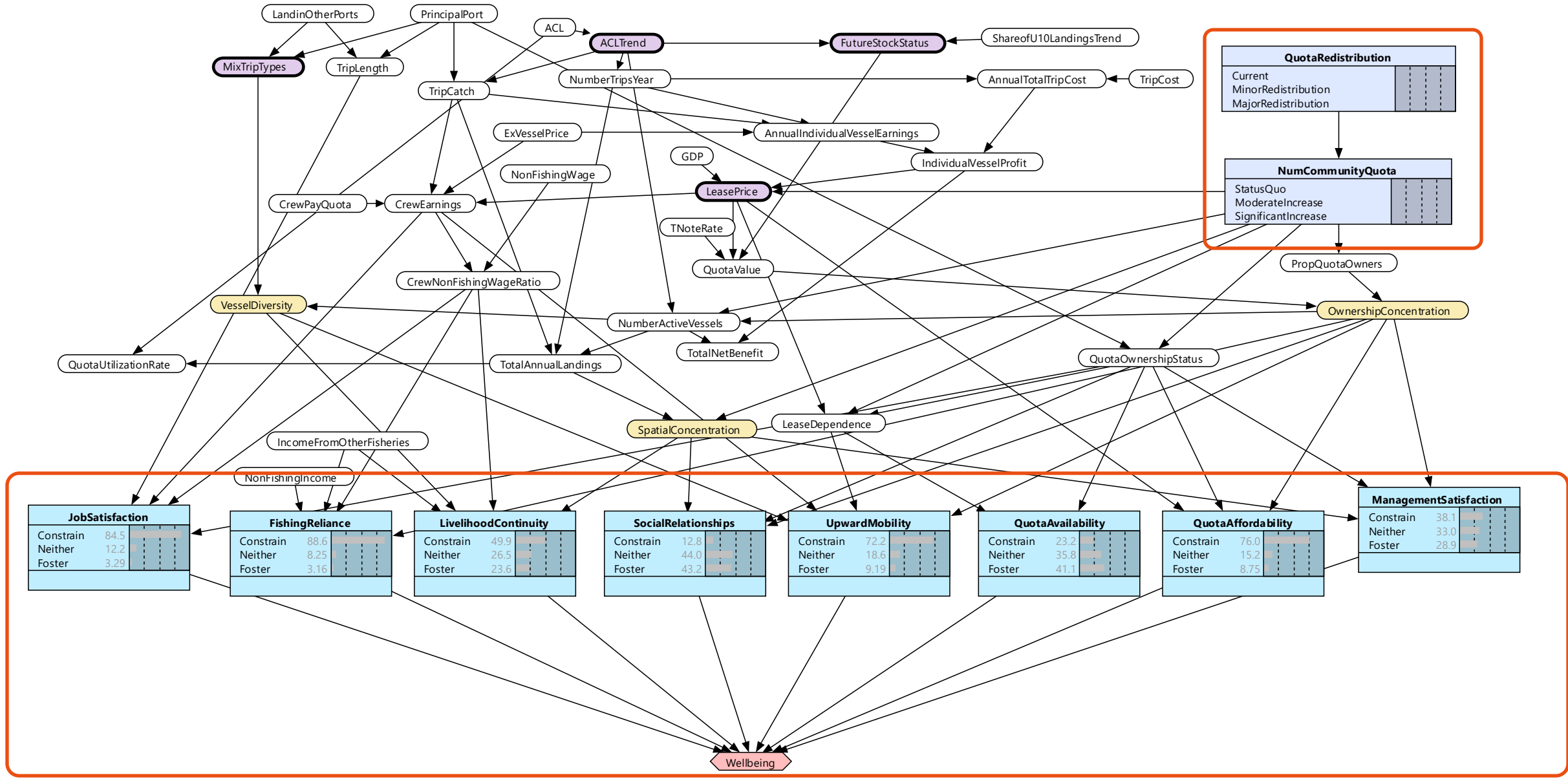
Industry
Survey

Decision
Model



Current (= near final) Version of the Model

Final model

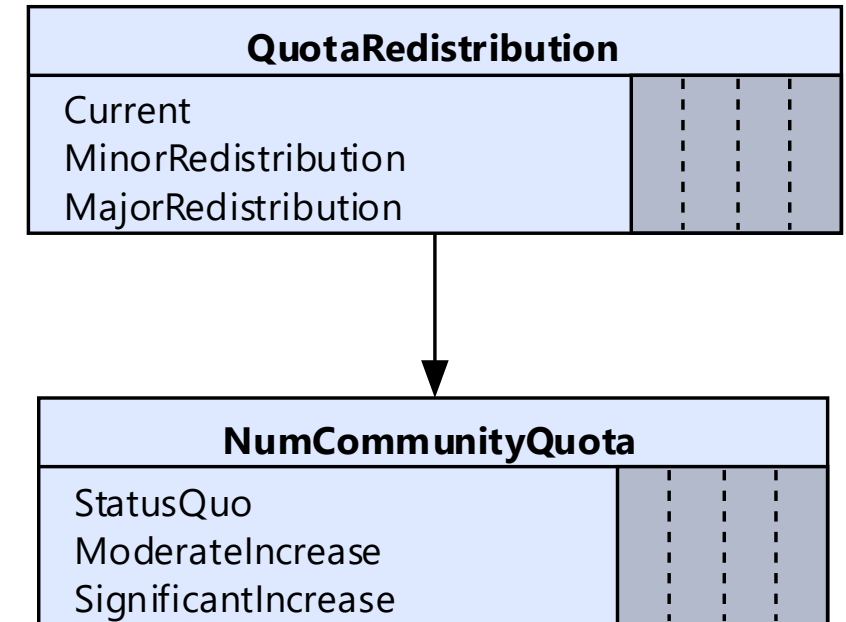


Intervention scenarios

- Management redistribute quotas into a separate pool dedicated for community ownership
- Communities determine whether to set up quota banks or analogous entities

3 Scenarios (associated implicit assumption)

- Status quo: 0 – 5 entities (~34% of New England participants have access to quota banks)
- Moderate increase: 5 – 10 entities (~ 71% of all participants have access to quota banks)
- Significant increase: 10 – 20 entities (All participants have access to quota banks)



Wellbeing nodes

- This is what we are optimizing for
- Data based on the survey
- Each wellbeing node takes the score between -2 and 2

Wellbeing dimensions

Corresponding score range

Wellbeing is constrained

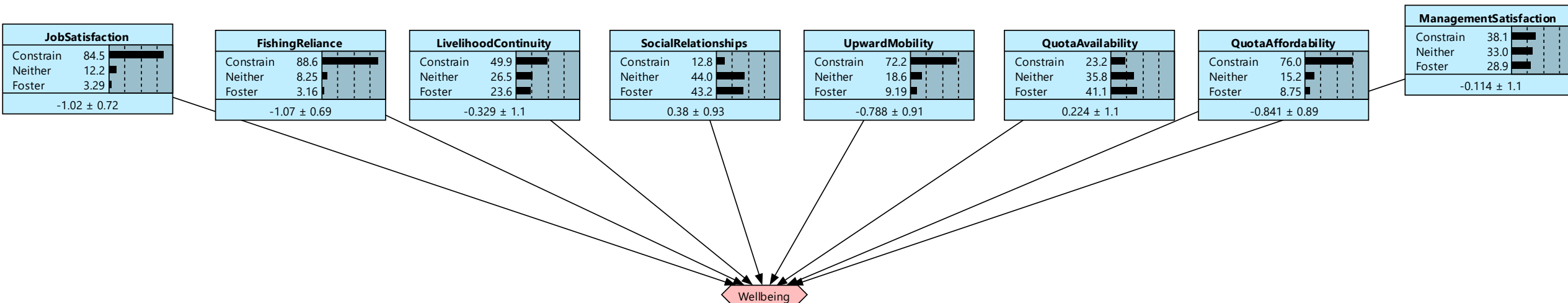
-2 to -0.5

Wellbeing is neither constrained nor fostered

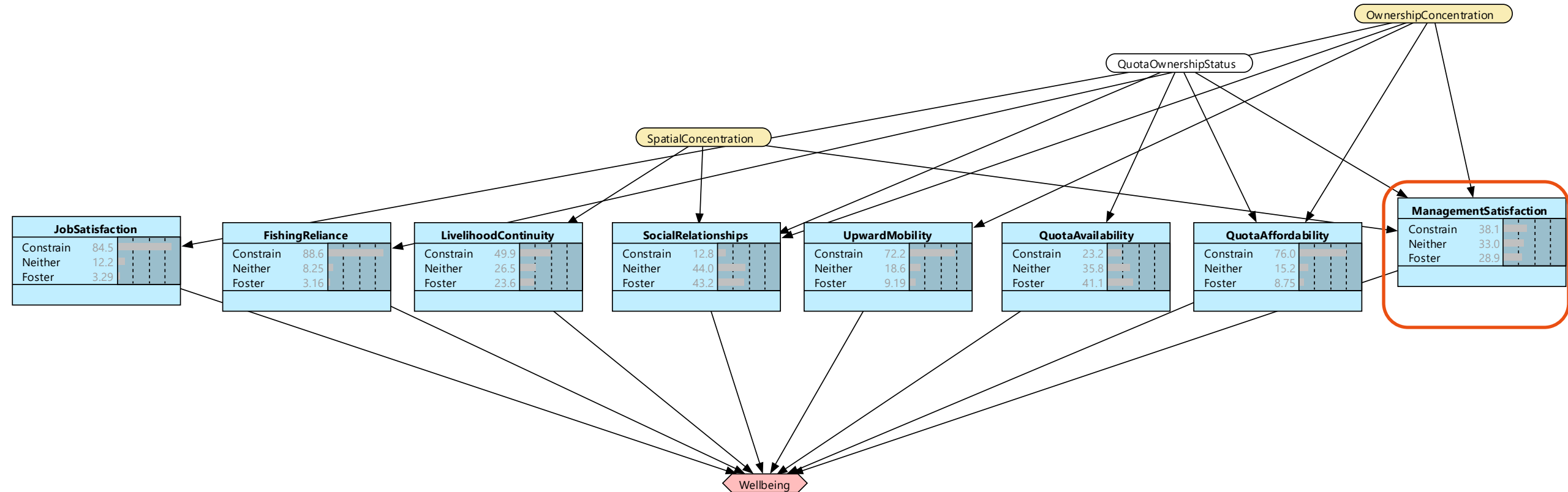
-0.5 to 0.5

Wellbeing is fostered

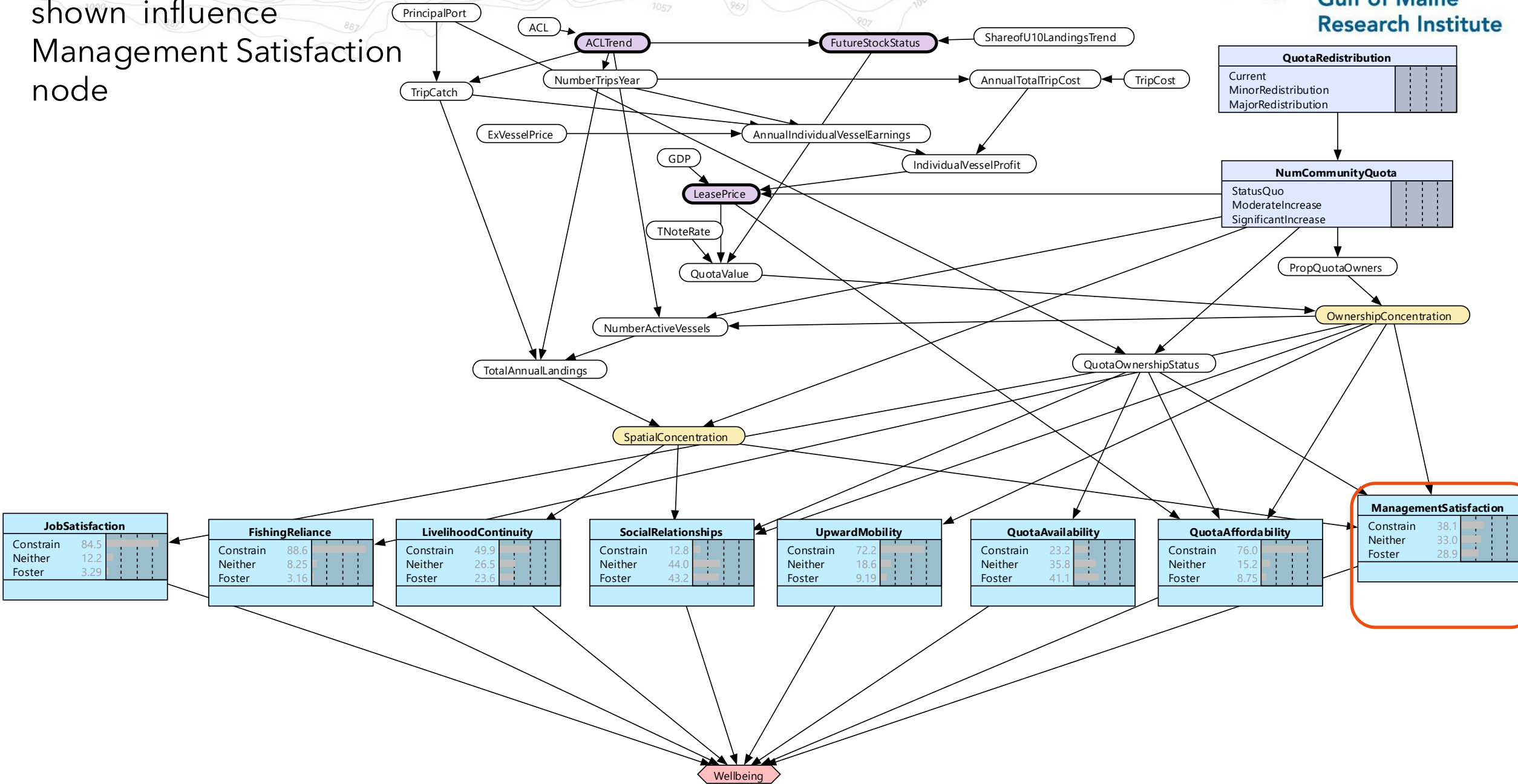
0.5 to 2



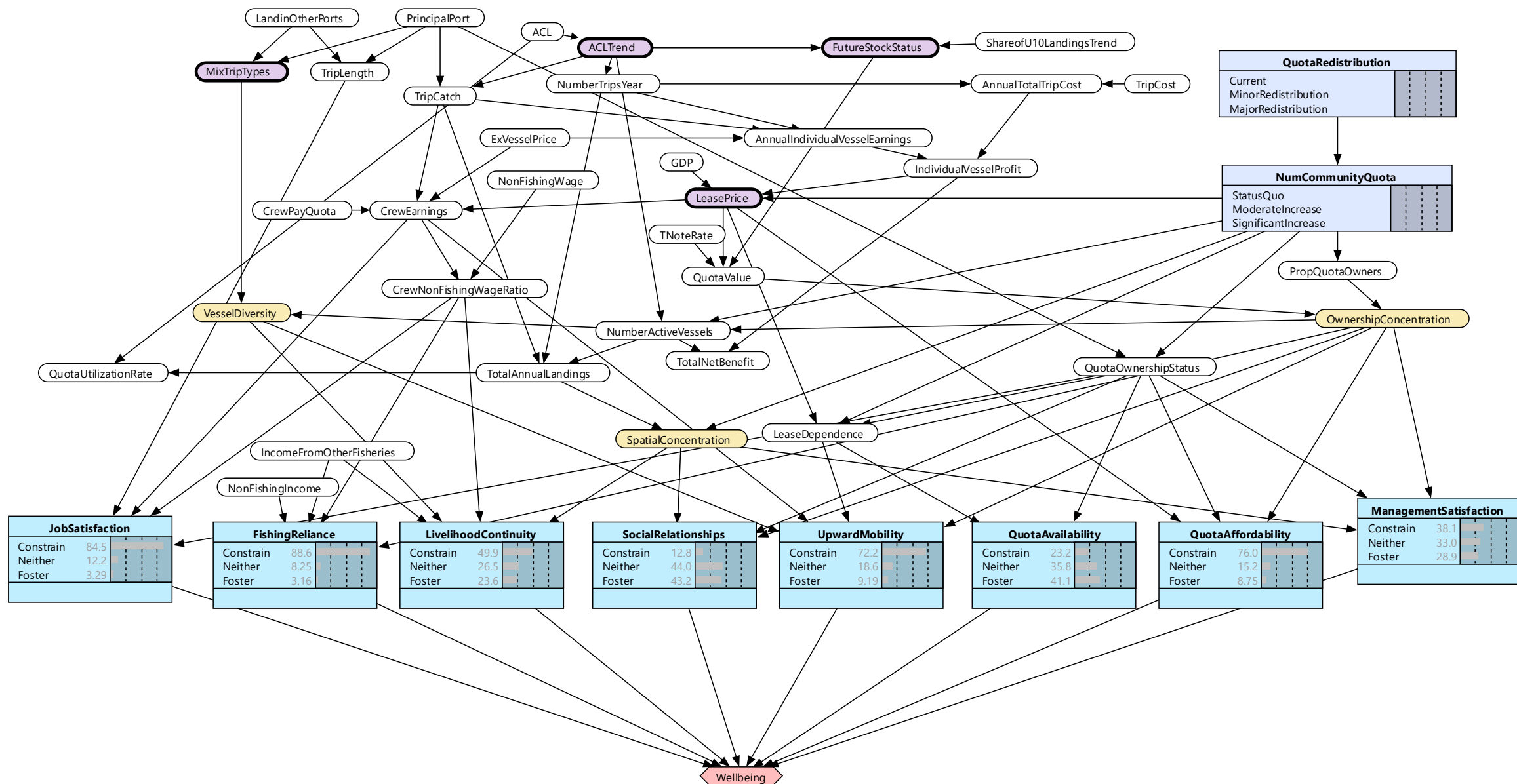
Explaining the complexity bottom up



The upstream nodes shown influence Management Satisfaction node



Current Model



Wellbeing dimensions considered in each model run

Model 1. Livelihood Continuity & Social Relationships

Model 2. Upward Mobility and Fishery Reliance

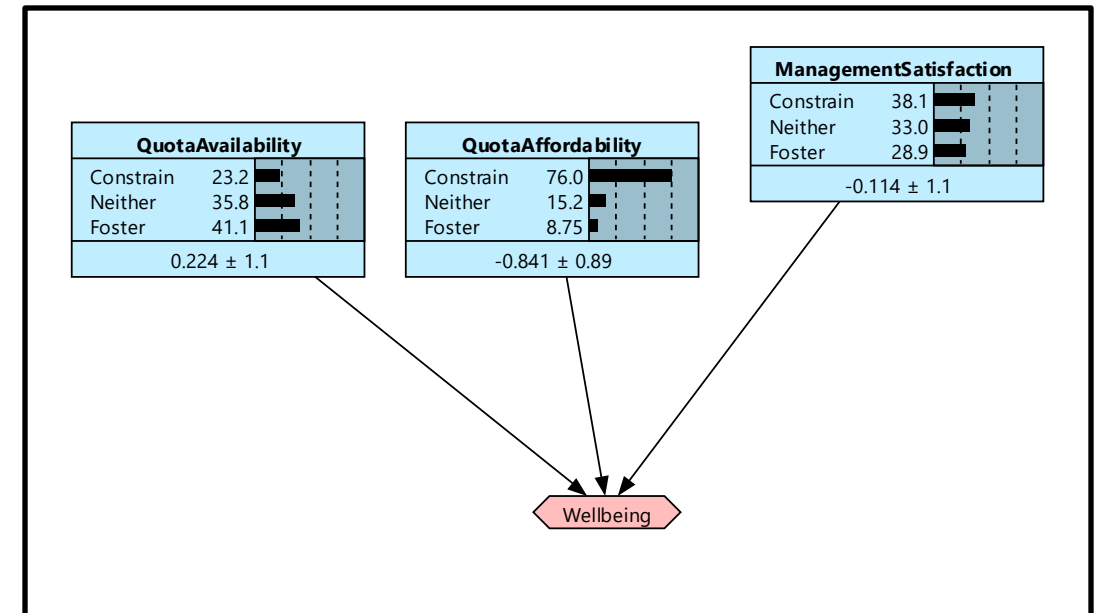
Model 3. Job Satisfaction and Management Satisfaction

Model 4. Quota Availability and Quota Affordability

Model 5. Job Satisfaction

Model 6. Quota Availability, Quota Affordability, and Management Satisfaction

All Wellbeing Nodes



Example. Model 6 run
(only the downstream component is depicted)

Preliminary Model Findings

Expected utility score range from -2 (constrained) to 2 (fostered)

	Expected Utility Under Alternative Decisions (normalized score)			Optimal Decision
	Status Quo (0 to 5 Quota Banks)	Moderate Increase (5 to 10 Quota Banks)	Significant Increase (10 to 20 Quota Banks)	
1. Livelihood Continuity & Social Relationships	-0.04	0.01	0.10	Significant Increase
2. Upward Mobility and Fishery Reliance	-1.02	-1.03	-1.00	Significant Increase
3. Job Satisfaction and Management Satisfaction	-0.51	-0.53	-0.48	Significant Increase
4. Quota Availability and Quota Affordability	-0.42	-0.45	-0.44	Status Quo
5. Job Satisfaction	-1.17	-1.16	-1.16	Moderate Increase
6. Quota Availability, Quota Affordability, and Management Satisfaction	-0.27	-0.30	-0.27	Significant Increase
All Wellbeing Nodes	-0.47	-0.47	-0.43	Significant Increase

- We explored potential wellbeing changes in the IFQ scallop fishery with an expansion in community quota ownership
- Survey findings describe perceptions on various wellbeing dimensions
- Bayesian belief decision model is a tool to explore and articulate IFQ scallop fishery system components and potential wellbeing changes
- Preliminary findings from the model suggest that a significant expansion in the community quota ownership has the potential to improve overall community wellbeing. However, it may not necessarily improve quota affordability and availability.

We appreciate **general feedback** on our research and findings as well as **suggestions for any modifications to the decision model** for further exploration.

Acknowledgement

- **Walton Family Foundation** for funding the project
- **Tom Sanborn**, Formerly at Northern Economics, for contributing to conducting interviews
- Connor Buckley and Jonathon Peros, NEFMC
- Various management and industry stakeholders for providing feedback, participating in interviews, and participating in the survey

Equity and Catch Shares White Paper
(Scan to view the PDF)



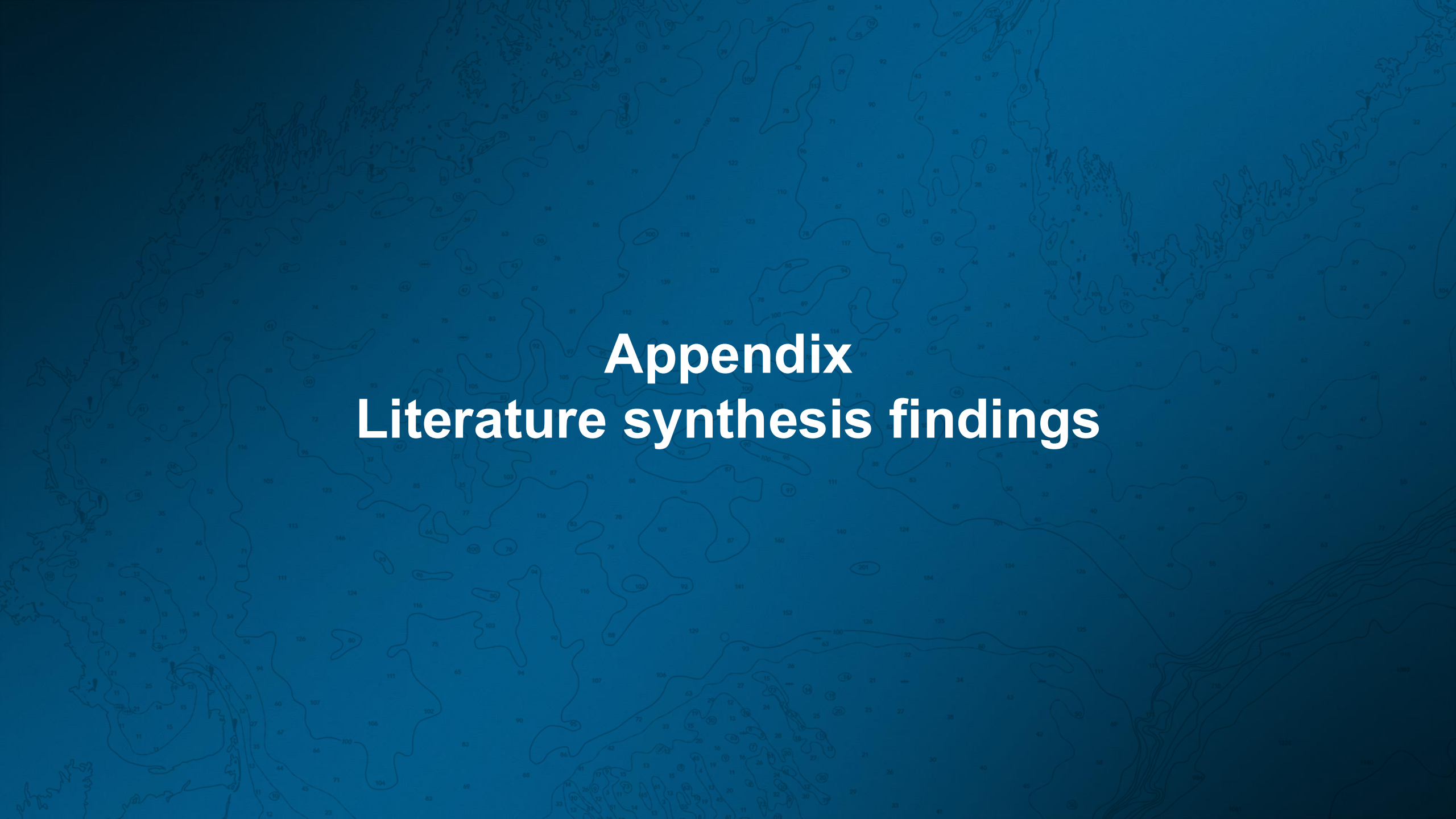
Equity and Catch Shares White Paper (Scan to view the PDF)



Kanae Tokunaga
ktokunaga@gmri.org

Thank you!



A dark blue background featuring a light blue topographic map. The map shows various landmasses, including parts of North America, Europe, and Asia, with numerous contour lines and numerical values indicating elevation or depth. The text is centered over the map.

Appendix

Literature synthesis findings

Wellbeing dimensions of focus within our case study

Wellbeing dimensions of focus	Description
Job satisfaction	Satisfaction with fishing as an occupation.
Individual fishing reliance	Reliance on fishing for income and occupation at the individual level.
Continuity of fishing as a livelihood	Perceptions of fishing being a continued livelihood option for fishing communities into the future.
Social relationships	Relationships with individuals within the fishery and fishing community, and between different fishing communities.
Management satisfaction	Satisfaction with fisheries management processes for the IFQ scallop fishery.
Availability and affordability of quota	Perceived affordability and availability of quota to lease or purchase.
Upward mobility within occupation	Ability and opportunity for fishery participants to move upwards within the profession, such as from crew to permit holder, vessel owner and quota shareholders.

Issues & remedial measures

Equity issue	Condensed overview of issue	Potential remedial measures (interventions)
Inequitable Initial Allocation of Fishing Privileges	Who is eligible for initial allocations and how are allocations shared? Issues include gifting of quota shares creating windfall wealth gains; restricting quota share allocation to fishing vessel owners only; use of historical catch determinations is subjective, may leave other important groups or users out.	Community, processor, or crew quota shares Auctions for allocating or re-allocating shares Redistribute quota
Acquisition of Excessive Share of Fishing Privileges	Concentration of fishing privileges after the initial allocation can lead to negative outcomes, like market power.	Accumulation limits (e.g., quota ownership caps, use caps) Leasing prohibitions Leasing or transfer restrictions
Disruption of Fishing Communities	Consolidation can lead to a smaller fleet and potential geographic redistribution of shares and landings. Decreases in fleet size can reduce crew positions available and employment in shoreside jobs, decrease tax revenue, and commercial footprints of waterfronts. Lost access to fisheries-related livelihoods can have health and wellbeing implications.	Community ownership of shares Permit/quota banks Quota set-asides Geographic landing requirements Grant communities 'right of first refusal' to buy shares
Loss of Diversity in Local Fishing Fleets	Catch share programs may result in reduced diversity—fishery specific (e.g., gear, vessels), and demographic, socioeconomic and cultural diversity (e.g., age, race, rurality)—through redistribution of fishing privileges among vessel classes, potentially benefiting larger vessels over smaller (due to higher earning power); reduced access to fisheries for young/small-scale/low-income/indigenous/minority/rural fishers.	Multiple quota groups Cooperative management Leasing prohibitions Quota set-asides Active participation requirements Economic assistance programs (e.g., subsidized loan programs)
Disadvantaging Crew Members	Crew members are generally excluded from initial quota share allocation. Crew can also be disadvantaged by fleet consolidation through reduced work opportunities and less power in negotiating pay. Crew may experience reduced pay through quota share leasing deductions.	Quota set-asides Direct allocations of quota shares to crew (crew quota shares) Economic assistance programs (e.g., subsidized loan programs) Redistribute quota based on crew experience
Spillover Effects on other Fisheries	Spillover of fishing effort into other commercial fisheries, due to fleet consolidation or loss of access to quota shares, can adversely affect other fishery participants. Potential impacts on the for-hire recreational sector are also possible.	Prohibit quota shareholders from non-catch share fishery participation Restrict other fishery harvest by quota shareholders
Decoupling of Quota Ownership from Active Fishermen	People who do not actively fish can hold, profit from, and trade quota shares or annual allocations ("armchair fishermen"). This can create social conflict and transfer economic wealth derived from fishing privileges out of these communities.	Leasing or transfer restrictions Active participation requirements
Barriers to New Entrants	Potential entrants face high start-up costs due to purchasing or leasing quota, impacting younger, less experienced fishers. Finding and negotiating with quota share sellers/leasers also involves high cost and effort, and knowledge of the market and value of these assets.	Leasing or transfer restrictions Quota set-asides Economic assistance programs (e.g., subsidized loan programs) Redistribute quota (e.g., 'use-it-or-lose-it' or 'lease to own' provisions) Redistribute increases in total allocation
Inter-sector Conflict over Access to Fishery Resources	Disputes or conflicts between commercial sector and recreational sector regarding how catch share programs may affect political power and allocations between sectors	Allow inter-sector purchase/transfer of quota shares

Socioeconomic impacts - concerns

National Standard 4 requires fair and equitable allocation

16 U.S. catch share programs' **goals and objectives**

- Preserve social structure and historical fishery participation (5)
- Minimize impacts on communities or other fisheries (4)
- Avoid excessive concentration (4)
- Create stability for fishing communities and businesses (3)
- Promote resilience (diversification, utilization, capital investment) (3)
- Avoid negative impacts from concentrated fishing effort (3)
- Encourage fleet diversity (3)
- Promote fairness and equity (2)
- Ensure local benefits and participation (2)
- Create opportunities for new entrants (1)

Issues identified

- Inequitable initial allocation of fishing privileges
- Acquisition of excessive share of fishing privileges
- Decoupling of quota ownership from active harvesters
- Disruption of fishing communities
- Loss of diversity in local fishing fleets
- Disadvantaging crew members
- Barriers to new entrants
- Inter-sector conflict over access to fishery resources
- Spillover effects on other fisheries
- Vagueness in assessing goals and objectives
- Data and information gaps

Distributive concerns

National Standard 4 requires fair and equitable allocation

16 U.S. catch share programs' **goals and objectives**

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- Encourage fleet diversity (3)
- Promote fairness and equity (2)
- Ensure local benefits and participation (2)
- Create opportunities for new entrants (1)

Distributive issues identified

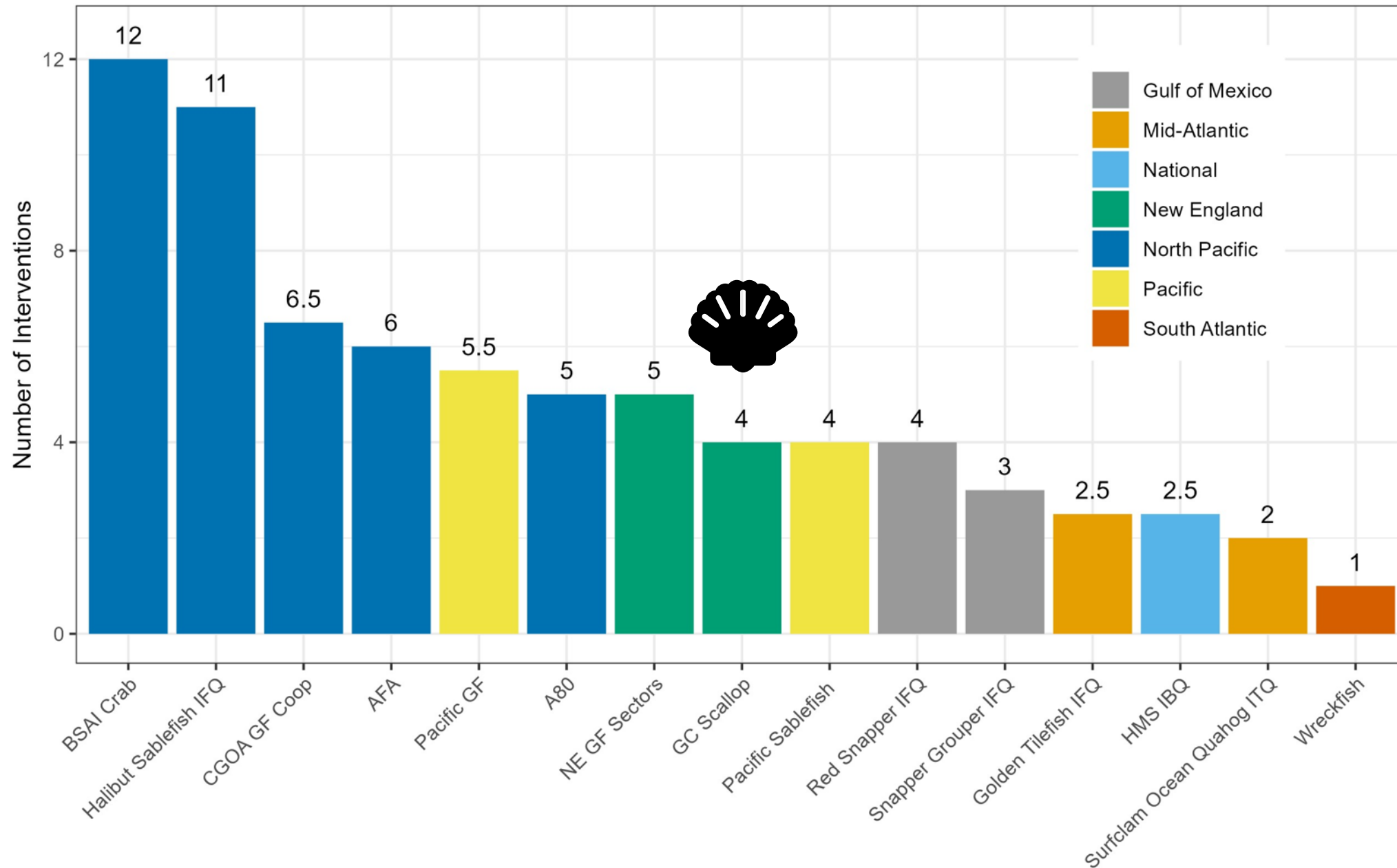
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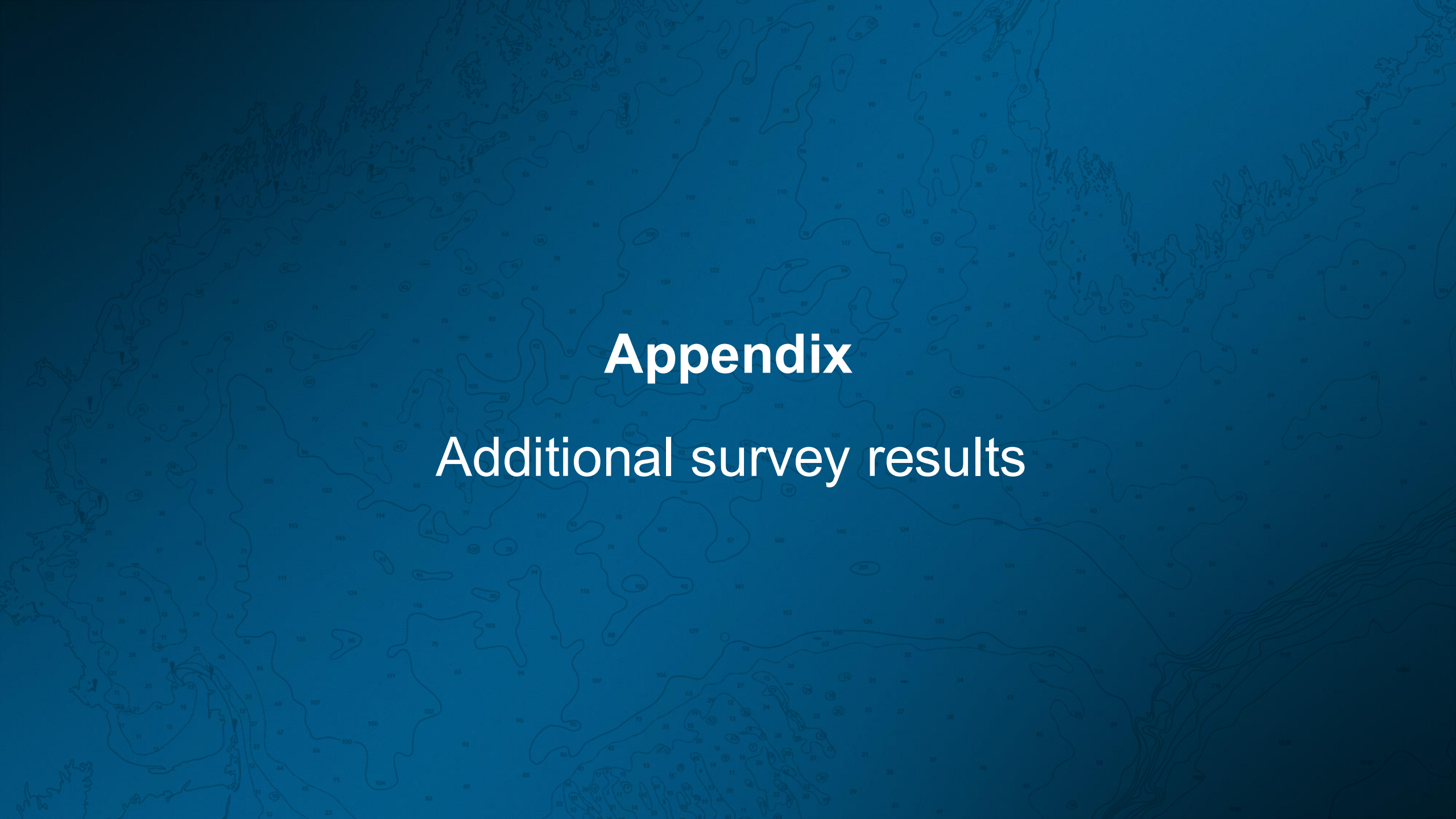
Assessing equity and wellbeing outcomes

- Northeast multispecies sector program review
 - Objectives that relate to equity are too vague and difficult to measure
- BSAI crab rationalization program's review
 - The assessment of the goal to address social and economic concerns of communities is too dependent on the community and stakeholder composition to succinctly assess progress in meeting it
- Halibut and sablefish IFQ program review
 - Objective of providing entry opportunities are broad and do not include specific, measurable targets
 - Many of these objectives are inherently conflicting
- NASEM committee (2024) recommendations
 - Principles to define equity
 - Data/information gathering
 - Multidimensional assessment of equity

Challenges assessing equity outcomes and effectiveness of remedial measures

Interventions Across Programs and Regions

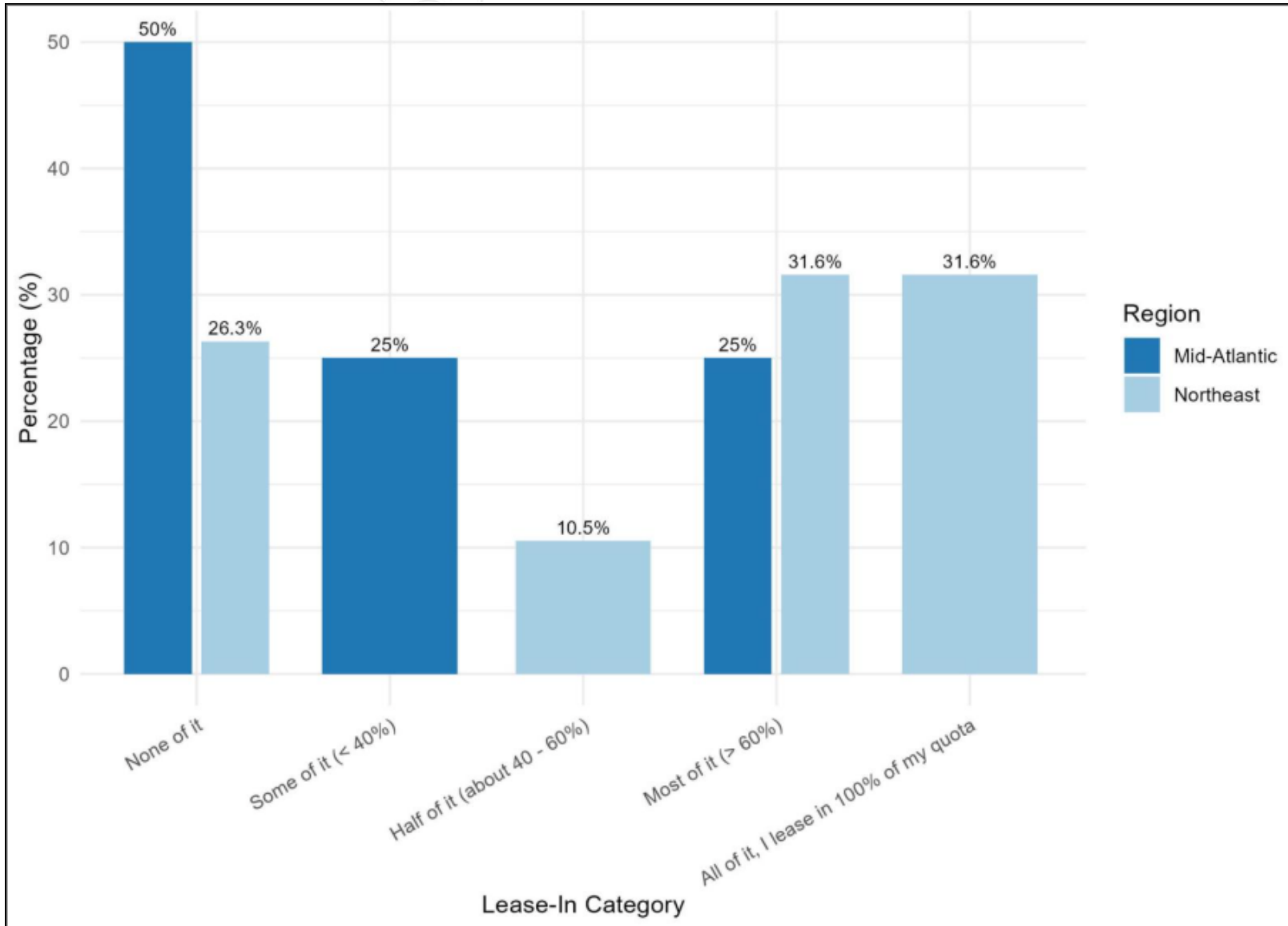


The background of the slide is a detailed contour map of the North Atlantic Ocean. The map features numerous contour lines representing depth or bathymetry, with numerical values ranging from 1 to over 1000. The map covers the area from the coast of North America on the left to the coast of Europe and Africa on the right, and from the Arctic region down to the Gulf of Mexico. The text 'Appendix' and 'Additional survey results' is overlaid in the center of the map.

Appendix

Additional survey results

What proportion of the quota used on your vessel is leased?



- Over half of all respondents leased in the majority to all of the quota used (n = 23)
- Over 1/4 of the respondents are 100% lease dependent
- Mid-Atlantic respondents broadly leased in less quota, but differences were not significant (T-test, $p = 0.13$)

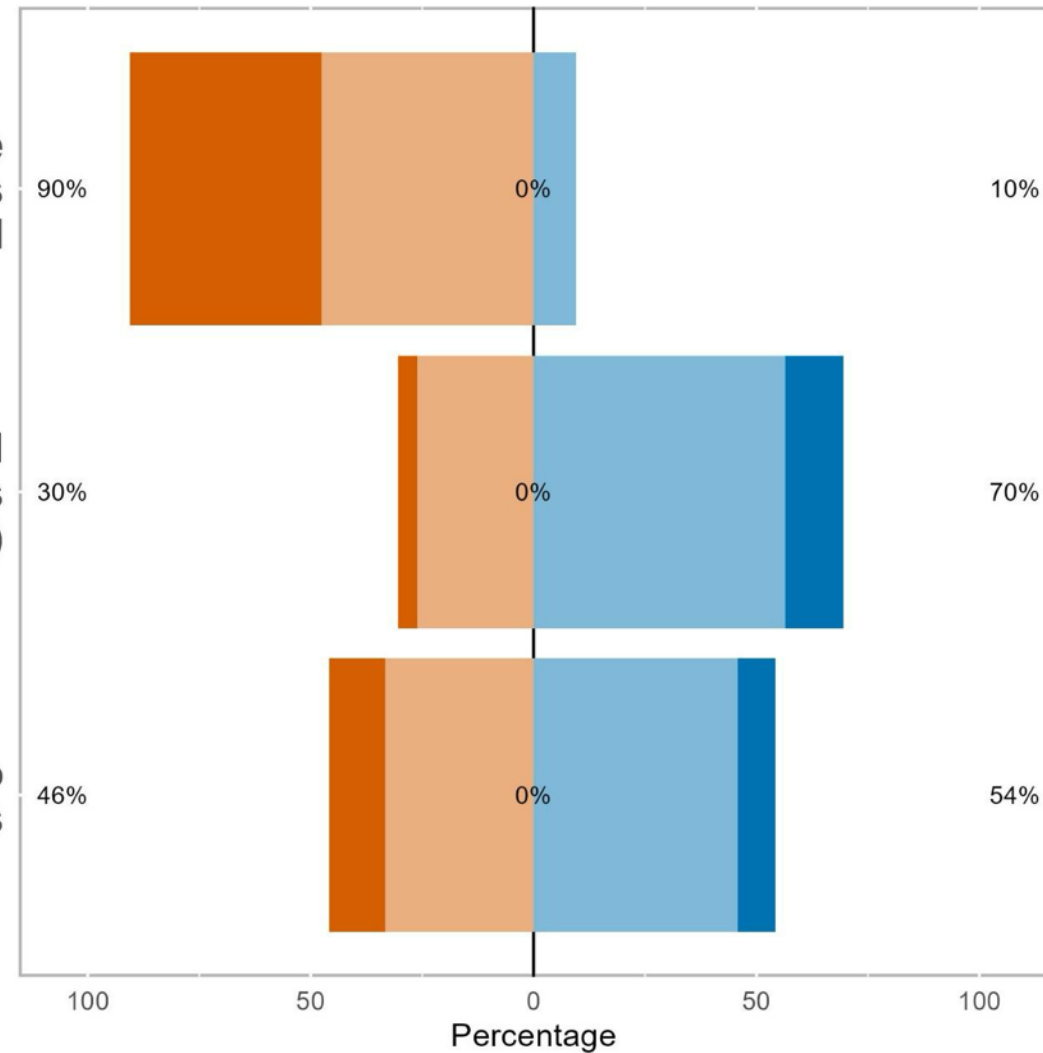
Management Perceptions

Management Relationships

Most of the fishermen in the LAGC IFQ fishery are generally satisfied with how the fishery is currently managed

Fishermen in the LAGC IFQ fishery are well informed about the fishery management processes (i.e. council actions)

Fishermen in the LAGC IFQ fishery are able to have a say in management decisions



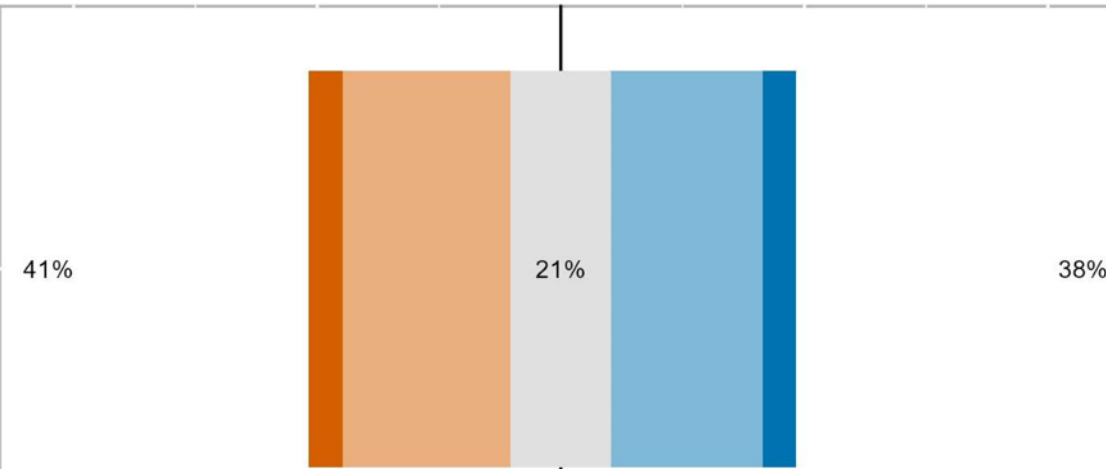
Response

 Strongly Disagree	 Neither Disagree Nor Agree	 Strongly Agree
 Disagree	 Agree	

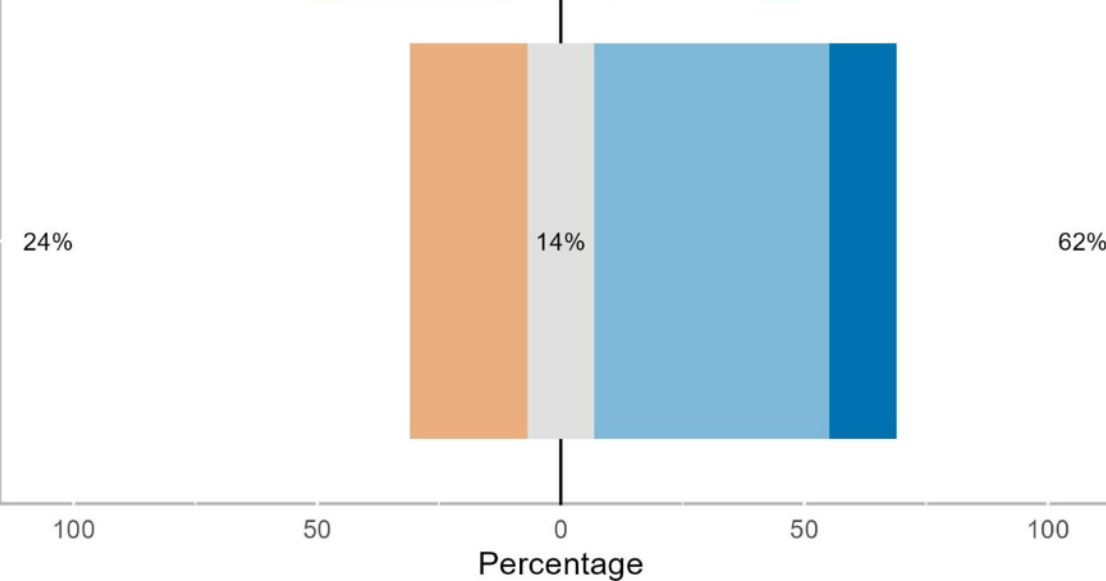
Can fishermen move up in their fishing careers?

Upward Mobility within the Occupation

There are opportunities for fishermen to move upwards within the profession



If fishermen work hard, they can successfully progress in their fishing careers



Response

	Strongly Disagree		Neither Disagree Nor Agree		Strongly Agree
	Disagree		Agree		

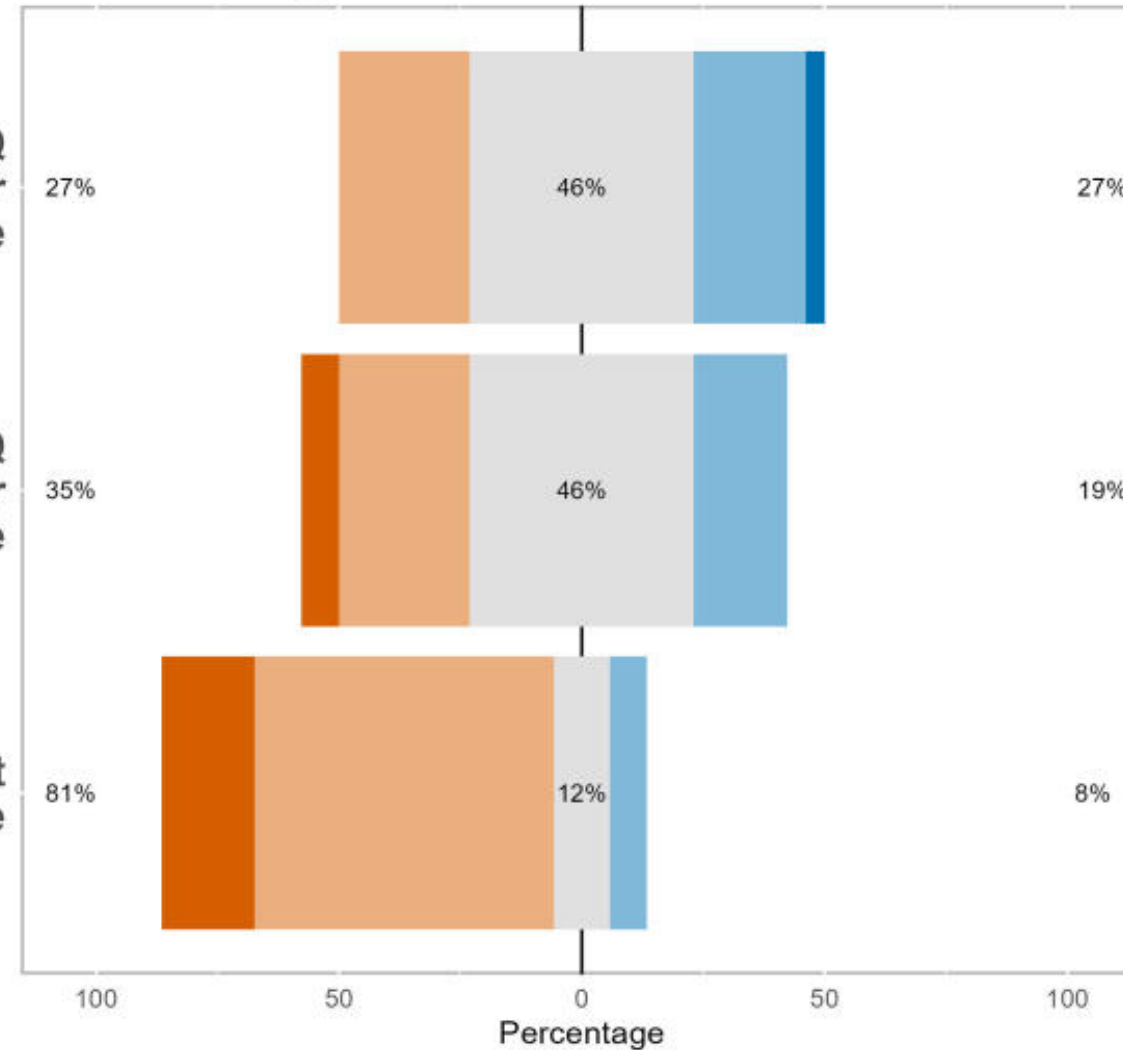
Reliance on IFQ scallop

Individual Fishing Reliance

Fishermen that participate in the LAGC IFQ fishery rely on non-fishing income sources for some of their total annual income

Fishermen that participate in the LAGC IFQ fishery are wholly reliant on the fishery for their annual fishing income

Being in the LAGC IFQ fishery means that fishermen's wages are stable and predictable

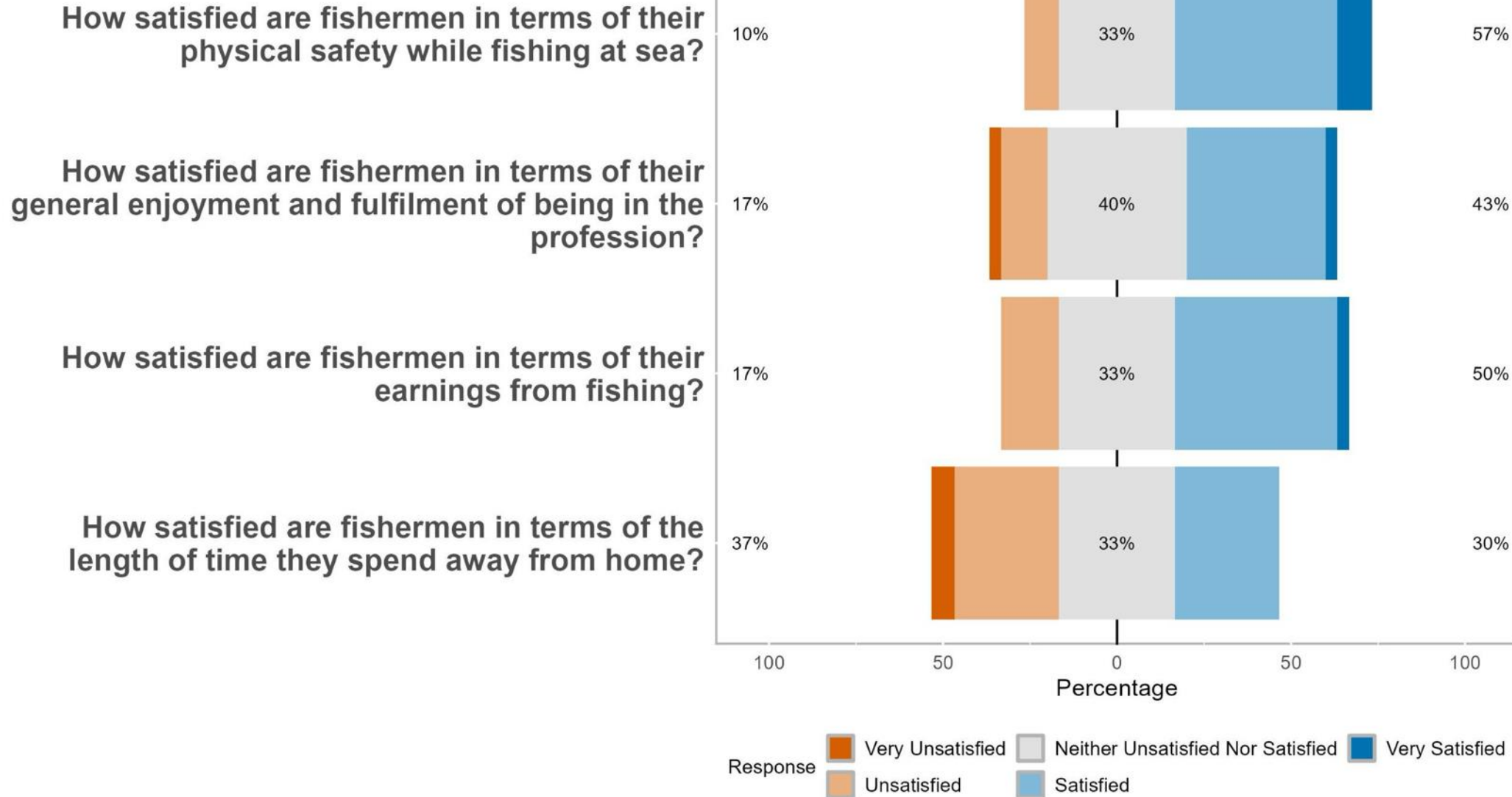


Response

Strongly Disagree	Neither Disagree Nor Agree	Strongly Agree
Disagree	Agree	

Job satisfaction

Job Satisfaction

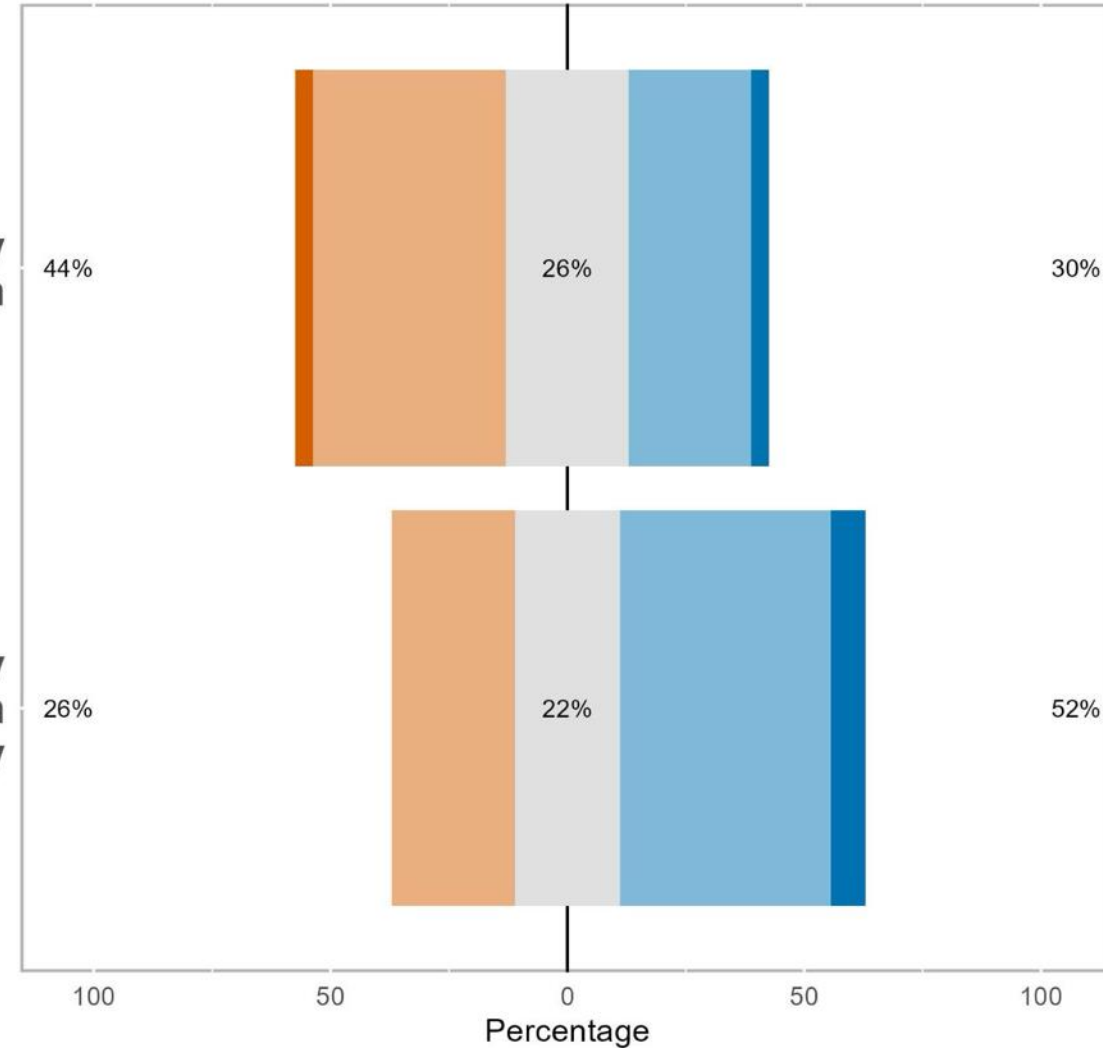


Mental wellbeing

Mental Wellbeing

The nature of the LAGC IFQ scallop fishery negatively impacts fishermen's mental health

Being in the LAGC IFQ fishery generally experience good mental health while working in the fishery

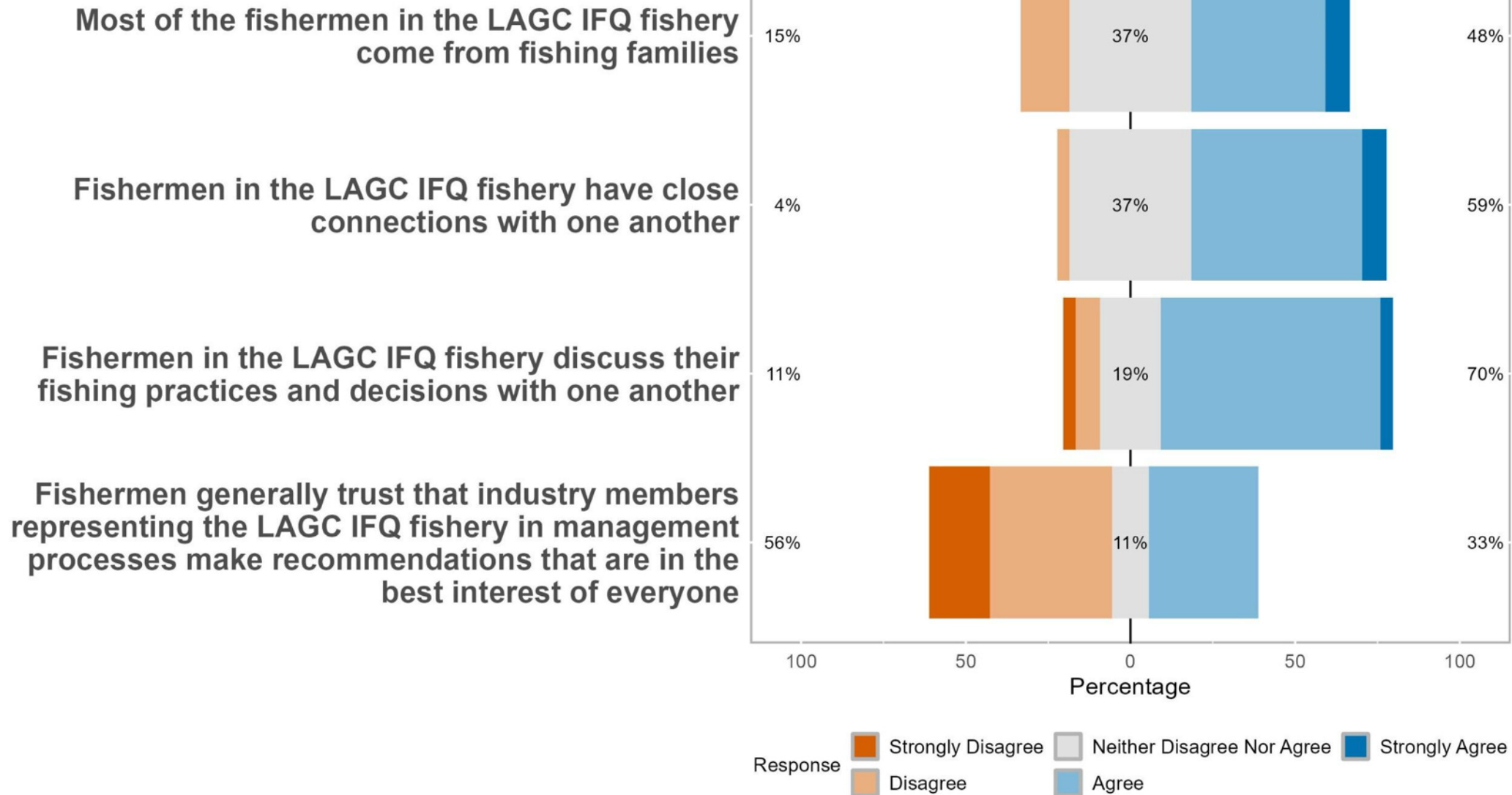


Response

	Strongly Disagree		Neither Disagree Nor Agree		Strongly Agree
	Disagree		Agree		

Social relationships

Social Relationships within the IFQ Fishery



A dark blue background featuring a detailed topographic map of a mountainous region. The map shows numerous contour lines and numerical elevation values, such as 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200, 210, 220, 230, 240, 250, 260, 270, 280, 290, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 410, 420, 430, 440, 450, 460, 470, 480, 490, 500, 510, 520, 530, 540, 550, 560, 570, 580, 590, 600, 610, 620, 630, 640, 650, 660, 670, 680, 690, 700, 710, 720, 730, 740, 750, 760, 770, 780, 790, 800, 810, 820, 830, 840, 850, 860, 870, 880, 890, 900, 910, 920, 930, 940, 950, 960, 970, 980, 990, 1000, 1010, 1020, 1030, 1040, 1050, 1060, 1070, 1080, 1090, 1100, 1110, 1120, 1130, 1140, 1150, 1160, 1170, 1180, 1190, 1200, 1210, 1220, 1230, 1240, 1250, 1260, 1270, 1280, 1290, 1300, 1310, 1320, 1330, 1340, 1350, 1360, 1370, 1380, 1390, 1400, 1410, 1420, 1430, 1440, 1450, 1460, 1470, 1480, 1490, 1500, 1510, 1520, 1530, 1540, 1550, 1560, 1570, 1580, 1590, 1600, 1610, 1620, 1630, 1640, 1650, 1660, 1670, 1680, 1690, 1700, 1710, 1720, 1730, 1740, 1750, 1760, 1770, 1780, 1790, 1800, 1810, 1820, 1830, 1840, 1850, 1860, 1870, 1880, 1890, 1900, 1910, 1920, 1930, 1940, 1950, 1960, 1970, 1980, 1990, 2000, 2010, 2020, 2030, 2040, 2050, 2060, 2070, 2080, 2090, 2100, 2110, 2120, 2130, 2140, 2150, 2160, 2170, 2180, 2190, 2200, 2210, 2220, 2230, 2240, 2250, 2260, 2270, 2280, 2290, 2300, 2310, 2320, 2330, 2340, 2350, 2360, 2370, 2380, 2390, 2400, 2410, 2420, 2430, 2440, 2450, 2460, 2470, 2480, 2490, 2500, 2510, 2520, 2530, 2540, 2550, 2560, 2570, 2580, 2590, 2600, 2610, 2620, 2630, 2640, 2650, 2660, 2670, 2680, 2690, 2700, 2710, 2720, 2730, 2740, 2750, 2760, 2770, 2780, 2790, 2800, 2810, 2820, 2830, 2840, 2850, 2860, 2870, 2880, 2890, 2900, 2910, 2920, 2930, 2940, 2950, 2960, 2970, 2980, 2990, 3000, 3010, 3020, 3030, 3040, 3050, 3060, 3070, 3080, 3090, 3100, 3110, 3120, 3130, 3140, 3150, 3160, 3170, 3180, 3190, 3200, 3210, 3220, 3230, 3240, 3250, 3260, 3270, 3280, 3290, 3300, 3310, 3320, 3330, 3340, 3350, 3360, 3370, 3380, 3390, 3400, 3410, 3420, 3430, 3440, 3450, 3460, 3470, 3480, 3490, 3500, 3510, 3520, 3530, 3540, 3550, 3560, 3570, 3580, 3590, 3600, 3610, 3620, 3630, 3640, 3650, 3660, 3670, 3680, 3690, 3700, 3710, 3720, 3730, 3740, 3750, 3760, 3770, 3780, 3790, 3800, 3810, 3820, 3830, 3840, 3850, 3860, 3870, 3880, 3890, 3900, 3910, 3920, 3930, 3940, 3950, 3960, 3970, 3980, 3990, 4000, 4010, 4020, 4030, 4040, 4050, 4060, 4070, 4080, 4090, 4100, 4110, 4120, 4130, 4140, 4150, 4160, 4170, 4180, 4190, 4200, 4210, 4220, 4230, 4240, 4250, 4260, 4270, 4280, 4290, 4300, 4310, 4320, 4330, 4340, 4350, 4360, 4370, 4380, 4390, 4400, 4410, 4420, 4430, 4440, 4450, 4460, 4470, 4480, 4490, 4500, 4510, 4520, 4530, 4540, 4550, 4560, 4570, 4580, 4590, 4600, 4610, 4620, 4630, 4640, 4650, 4660, 4670, 4680, 4690, 4700, 4710, 4720, 4730, 4740, 4750, 4760, 4770, 4780, 4790, 4800, 4810, 4820, 4830, 4840, 4850, 4860, 4870, 4880, 4890, 4900, 4910, 4920, 4930, 4940, 4950, 4960, 4970, 4980, 4990, 5000, 5010, 5020, 5030, 5040, 5050, 5060, 5070, 5080, 5090, 5100, 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6770, 6780, 6790, 6800, 6810, 6820, 6830, 6840, 6850, 6860, 6870, 6880, 6890, 6900, 6910, 6920, 6930, 6940, 6950, 6960, 6970, 6980, 6990, 7000, 7010, 7020, 7030, 7040, 7050, 7060, 7070, 7080, 7090, 7100, 7110, 7120, 7130, 7140, 7150, 7160, 7170, 7180, 7190, 7200, 7210, 7220, 7230, 7240, 7250, 7260, 7270, 7280, 7290, 7300, 7310, 7320, 7330, 7340, 7350, 7360, 7370, 7380, 7390, 7400, 7410, 7420, 7430, 7440, 7450, 7460, 7470, 7480, 7490, 7500, 7510, 7520, 7530, 7540, 7550, 7560, 7570, 7580, 7590, 7600, 7610, 7620, 7630, 7640, 7650, 7660, 7670, 7680, 7690, 7700, 7710, 7720, 7730, 7740, 7750, 7760, 7770, 7780, 7790, 7800, 7810, 7820, 7830, 7840, 7850, 7860, 7870, 7880, 7890, 7900, 7910, 7920, 7930, 7940, 7950, 7960, 7970, 7980, 7990, 8000, 8010, 8020, 8030, 8040, 8050, 8060, 8070, 8080, 8090, 8100, 8110, 8120, 8130, 8140, 8150, 8160, 8170, 8180, 8190, 8200, 8210, 8220, 8230, 8240, 8250, 8260, 8270, 8280, 8290, 8300, 8310, 8320, 8330, 8340, 8350, 8360, 8370, 8380, 8390, 8400, 8410, 8420, 8430, 8440, 8450, 8460, 8470, 8480, 8490, 8500, 8510, 8520, 8530, 8540, 8550, 8560, 8570, 8580, 8590, 8600, 8610, 8620, 8630, 8640, 8650, 8660, 8670, 8680, 8690, 8700, 8710, 8720, 8730, 8740, 8750, 8760, 8770, 8780, 8790, 8800, 8810, 8820, 8830, 8840, 8850, 8860, 8870, 8880, 8890, 8900, 8910, 8920, 8930, 8940, 8950, 8960, 8970, 8980, 8990, 9000, 9010, 9020, 9030, 9040, 9050, 9060, 9070, 9080, 9090, 9100, 9110, 9120, 9130, 9140, 9150, 9160, 9170, 9180, 9190, 9200, 9210, 9220, 9230, 9240, 9250, 9260, 9270, 9280, 9290, 9300, 9310, 9320, 9330, 9340, 9350, 9360, 9370, 9380, 9390, 9400, 9410, 9420, 9430, 9440, 9450, 9460, 9470, 9480, 9490, 9500, 9510, 9520, 9530, 9540, 9550, 9560, 9570, 9580, 9590, 9600, 9610, 9620, 9630, 9640, 9650, 9660, 9670, 9680, 9690, 9700, 9710, 9720, 9730, 9740, 9750, 9760, 9770, 9780, 9790, 9800, 9810, 9820, 9830, 9840, 9850, 9860, 9870, 9880, 9890, 9900, 9910, 9920, 9930, 9940, 9950, 9960, 9970, 9980, 9990, 10000. The text is centered over the map.

Appendix

Additional modeling details

Equations used to determine prior probabilities

AnnualIndividualVesselEarnings (NumberTripsYear, TripCatch, ExVesselPrice) =

$\min(\text{ExVesselPrice} * \text{TripCatch} * \text{NumberTripsYear}, 1250000)$

AnnualTotalTripCost (NumberTripsYear, TripCost) =

$\min(\text{NumberTripsYear} * \text{TripCost}, 360000)$

CrewEarnings (LeasePrice, CrewPayQuota, ExVesselPrice, TripCatch) =

$\text{CrewPayQuota} == \text{Yes} ? \max(0, (\text{ExVesselPrice} - \text{LeasePrice}) * \text{TripCatch} * 0.46) :$

$\text{CrewPayQuota} == \text{No} ? \max(0, \text{ExVesselPrice} * \text{TripCatch} * 0.46) :$

$\max(0, \text{ExVesselPrice} * \text{TripCatch} * 0.46)$

CrewNonFishingWageRatio (CrewEarnings, NonFishingWage) =

$\text{CrewEarnings} < \text{NonFishingWage} * 0.8 ? \text{Low} :$

$\text{CrewEarnings} > \text{NonFishingWage} * 1.2 ? \text{High} :$

Equivalent

LeasePrice (GDP, IndividualVesselProfit, NumCommunityQuota) =

$\max(0, -14.725 + 1.132 * \text{GDP} + 0.085 * \text{IndividualVesselProfit} - 0.038 * \text{NumCommunityQuota})$

$p(\text{PropQuotaOwners} | \text{NumCommunityQuota}) =$

$\text{NumCommunityQuota} == \text{StatusQuo} ? \text{TriangularEnd3Dist}(\text{PropQuotaOwners}, 68, 20, 80) :$

$\text{NumCommunityQuota} == \text{ModerateIncrease} ? \text{TriangularEnd3Dist}(\text{PropQuotaOwners}, 58, 20, 80) :$

$\text{TriangularEnd3Dist}(\text{PropQuotaOwners}, 58, 20, 80)$

QuotaUtilizationRate (TotalAnnualLandings, ACL) =

$\text{TotalAnnualLandings} / (\text{ACL} * 2204.62 / 1000000) * 100$

TotalAnnualLandings (NumberTripsYear, NumberActiveVessels, TripCatch) =

$\min(\text{NumberTripsYear} * \text{TripCatch} * \text{NumberActiveVessels} / 1000000, 6)$

$P(\text{TotalNetBenefit} | \text{IndividualVesselProfit}, \text{NumberActiveVessels}) =$

$\text{NormalDist}(\text{TotalNetBenefit}, \text{IndividualVesselProfit} * \text{NumberActiveVessels} / 1000000, 1)$

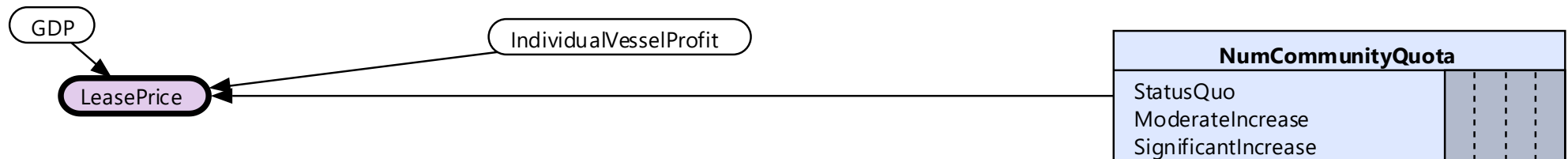
Wellbeing (QuotaAffordability, ManagementSatisfaction, QuotaAvailability) =

$\text{QuotaAffordability} + \text{ManagementSatisfaction} + \text{QuotaAffordability}$

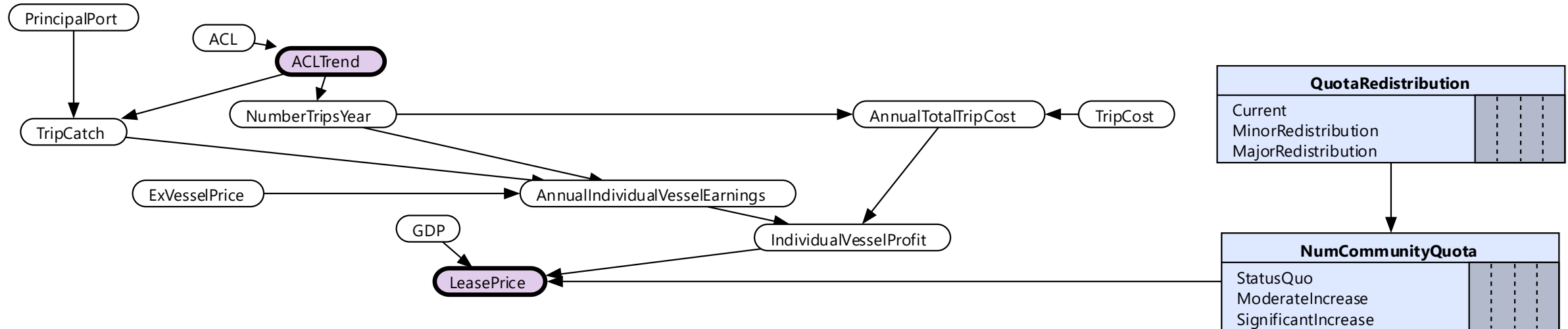
Lease price (with parent nodes)

Conditional probabilities (i.e., prior probabilities) for the Lease Price node was determined by following Jin, D., Lee, M.-Y., and Thunberg, E. 2019. An Empirical Analysis of Individual Fishing Quota Market Trading. Marine Resource Economics, 34: 39–57.

LeasePrice (GDP, IndividualVesselProfit, NumCommunityQuota) =
 $\max(0, -14.725 + 1.132 * \text{GDP} + 0.085 * \text{IndividualVesselProfit} - 0.038 * \text{NumCommunityQuota})$



Lease price (with ancestor nodes)



Quota value (with parent nodes)

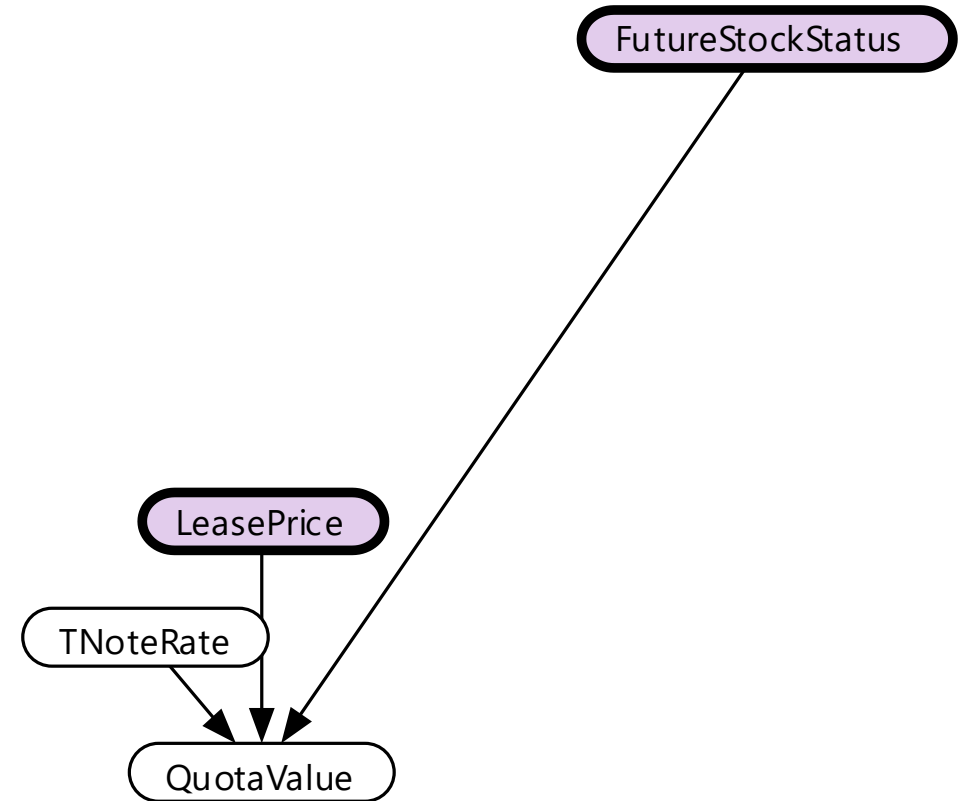
Conditional probabilities (i.e., prior probabilities) for the Quota Value node was informed by following Jin, D., Lee, M.-Y., and Thunberg, E. 2019. An Empirical Analysis of Individual Fishing Quota Market Trading. *Marine Resource Economics*, 34: 39–57.

Jin et al. estimates that

$$\ln(\text{Quota Value}) = \text{intercept}(=1.021) + 1.234 \cdot \ln(\text{IFQ lease price}) + (-0.282) \cdot \ln(\text{T-note rate}) + (-0.156) \cdot \text{SpringDummy} + (0.199) \cdot \text{FishingYear2013Dummy}$$

We set SpringDummy = 0 and FishingYear2013Dummy = 0.

If Future Stock Status is up (down), the quota price (determined by the above equation) as assumed to increase (decrease) the quota value by 10%.



Quota value (with ancestor nodes)

