***Supplementary Material***

# Supplementary Figures and Tables

## Supplementary Figures

**Supplementary Figure 1.** The baseline model sign directed graph developed from the variables identified in Supplementary Table 1. The variables in the same shape and color represent similar roles within the QNM. A line terminated with an arrowhead indicates a positive influence and a line with a dot indicates a negative relationship. Nodes are aligned for readability and order does not indicate variable interaction.

## Supplementary Tables

**Supplementary Table 1.** Description of variables, their linkages, and references used within the five QNMs (baseline, highgrading, avoidance behaviors, IFQ leasing and IFQ stacking).

|  |  |  |  |
| --- | --- | --- | --- |
| From | To | Link Direction | References |
| Average Price | IFQ Leasing | Negative | Anderson and Seijo 2010; Szymkowiak and Himes-Cornell 2015; Szymkowiak and Felthoven 2016; Interviews |
| Average Price | Lease Fees | Positive | Anderson and Seijo 2010; Szymkowiak and Himes-Cornell 2015; Szymkowiak and Felthoven 2016; Interviews |
| Average Price | QS Prices | Positive | Anderson and Seijo 2010; Szymkowiak and Himes-Cornell 2015; Szymkowiak and Felthoven 2016; Interviews |
| Average Fishing Costs | IFQ Leasing | Positive | NPFMC/NMFS 2016; Szymkowiak and Felthoven 2016; Interviews |
| Average Fishing Costs | IFQ Stacking | Positive | NPFMC/NMFS 2016; Hanselman et al. 2019; NPFMC 2013; NPFMC 2015; Interviews |
| Average Fishing Costs | Lease Fees | Negative | NPFMC/NMFS 2016; Anderson and Seijo 2010; Interviews |
| Average Fishing Costs | QS Prices | Negative | Anderson and Seijo 2010; NPFMC/NMFS 2016; Interviews |
| Average Fishing Costs | Avoidance Behavior | Negative | Peterson and Carothers 2013; Peterson et al. 2014; Interviews |
| Average Fishing Costs | Highgrading/ Discarding | Negative | NPFMC 2018; 2019; 2019b; Hanselman et al. 2019; Interviews |
| Average Fishing Costs | Livelihood | Negative | Peterson and Carothers 2013; Peterson et al. 2014; Rosellon-Druker, *forthcoming*; Interviews |
| Average Fishing Costs | Political Participation | Positive | Szymkowiak and Kasperski, *forthcoming*; NPFMC 2013; NPFMC 2018; Interviews |
| Average Price | Avoidance Behavior | Negative | NPFMC 2018; 2019; 2019b; Interviews |
| Average Price | Fisheries Participation (Effort) | Positive | Anderson and Seijo 2010; Rosellon-Druker, *forthcoming*; Interviews |
| Average Price | Gross Revenue | Positive | Anderson and Seijo 2010; Interviews |
| Average Price | Highgrading/ Discarding | Negative | NPFMC 2018; 2019; 2019b; Interviews |
| Avoidance Behavior | Average Fishing Costs | Positive | Peterson and Carothers 2013; Peterson et al. 2014; Interviews |
| Avoidance Behavior | Average Price | Positive | NPFMC 2018; 2019; 2019b; Interviews |
| Avoidance Behavior | Family Connection | Negative | Interviews |
| Avoidance Behavior | Mental Health | Negative | Interviews |
| Avoidance Behavior | Non-target Bycatch | Positive | Hanselman et al. 2019; Interviews |
| Avoidance Behavior | Physical Health | Negative | Szymkowiak and Kasperski, *forthcoming*; Interviews |
| Avoidance Behavior | Physical Safety | Negative | Interviews |
| Avoidance Behavior | Sense of Enjoyment/Fulfillment | Negative | Interviews |
| Avoidance Behavior | Whale Depredation | Negative | Peterson and Carothers 2013; Peterson et al. 2014 |
| Consolidation | Cultural Values & Traditions | Negative | Carothers 2010; Carothers 2015; Ringer et al. 2018 |
| Consolidation | Education/ Information | Negative | Carothers 2010; Carothers 2015; Ringer et al. 2018 |
| Consolidation | Family Heritage | Negative | Carothers 2010; Carothers 2015; Ringer et al. 2018 |
| Consolidation | Gear Conflicts | Negative | NPFMC/NMFS 2016 |
| Consolidation | Personal Development | Negative | Carothers 2010; Carothers 2015; Ringer et al. 2018 |
| Consolidation | Physical Safety | Positive | Carothers 2010; Carothers 2015; Ringer et al. 2018 |
| Consolidation | Resilience | Negative | Carothers 2010; Carothers 2015; Ringer et al. 2018 |
| Consolidation | Sense of Community | Negative | Carothers 2010; Carothers 2015; Ringer et al. 2018 |
| Consolidation | Social Justice & Equity | Negative | Carothers 2010; Carothers 2015; Ringer et al. 2018 |
| Consolidation | Sustainability | Negative | Carothers 2010; Carothers 2015; Ringer et al. 2018 |
| Fisheries Participation (Effort) | Average Fishing Costs | Positive | Anderson and Seijo 2010 |
| Fisheries Participation (Effort) | Connection to Ecosystem | Positive | Carothers 2010; Carothers 2015; Ringer et al. 2018; Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Cultural Values & Traditions | Positive | Carothers 2010; Carothers 2015; Ringer et al. 2018; Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Education/ Information | Positive | Carothers 2010; Carothers 2015; Ringer et al. 2018; Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Family Connection | Positive | Carothers 2010; Carothers 2015; Ringer et al. 2018; Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Family Heritage | Positive | Carothers 2010; Carothers 2015; Ringer et al. 2018; Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Food/Nutrition | Positive | Carothers 2010; Carothers 2015; Ringer et al. 2018; Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Governance/ Management | Positive | Carothers 2015; Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Harvest (Lbs.) | Positive | Anderson and Seijo 2010; Rosellon-Druker, *forthcoming* |
| Fisheries Participation (Effort) | Identity | Positive | Carothers 2010; Carothers 2015; Ringer et al. 2018; Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Income Security | Positive | Carothers 2010; Carothers 2015; Ringer et al. 2018; Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Local Food Security | Positive | Carothers 2010; Carothers 2015; Ringer et al. 2018; Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Mental Health | Positive | Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | National Economy | Positive | Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | National Food Security | Positive | Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Personal Development | Positive | Carothers 2010; Carothers 2015; Ringer et al. 2018; Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Physical Health | Positive | Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Physical Safety | Positive | Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Political Participation | Positive | Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Resilience | Positive | Carothers 2010; Carothers 2015; Ringer et al. 2018; Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Self Determination | Positive | Carothers 2010; Carothers 2015; Ringer et al. 2018; Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Sense of Community | Positive | Carothers 2010; Carothers 2015; Ringer et al. 2018; Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Sense of Enjoyment/Fulfillment | Positive | Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Sense of Place | Positive | Carothers 2010; Carothers 2015; Ringer et al. 2018; Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Social Justice & Equity | Positive | Carothers 2010; Carothers 2015; Ringer et al. 2018; Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Stewardship | Positive | Carothers 2010; Carothers 2015; Ringer et al. 2018; Szymkowiak and Kasperski, *forthcoming* |
| Fisheries Participation (Effort) | Sustainability | Positive | Carothers 2010; Carothers 2015; Ringer et al. 2018; Szymkowiak and Kasperski, *forthcoming* |
| Gear Conflicts | Education/ Information | Negative | NPFMC 2013; NPFMC 2015; NPFMC/NMFS 2016 |
| Gear Conflicts | Food/ Nutrition | Negative | NPFMC 2013; NPFMC 2015; NPFMC/NMFS 2016 |
| Gear Conflicts | Governance/ Management | Negative | NPFMC 2013; NPFMC 2015; NPFMC/NMFS 2016; Interviews |
| Gear Conflicts | Physical Safety | Negative | NPFMC/NMFS 2016; Interviews |
| Gear Conflicts | Resilience | Negative | NPFMC/NMFS 2016; Interviews |
| Gear Conflicts | Self Determination | Negative | NPFMC/NMFS 2016; Interviews |
| Gear Conflicts | Sense of Community | Negative | NPFMC/NMFS 2016; Interviews |
| Gear Conflicts | Stewardship | Negative | NPFMC/NMFS 2016; Interviews |
| Gear Conflicts | Sustainability | Negative | NPFMC/NMFS 2016; Interviews |
| Gross Revenue | Income Security | Positive | NPFMC/NMFS 2016 |
| Gross Revenue | Lease Fees | Positive | Anderson and Seijo 2010; NPFMC/NMFS 2016 |
| Gross Revenue | Livelihood | Positive | NPFMC/NMFS 2016; Interviews |
| Gross Revenue | National Economy | Positive | NPFMC/NMFS 2016 |
| Gross Revenue | Political Participation | Negative | Szymkowiak and Kasperski, *forthcoming*; Interviews |
| Gross Revenue | QS Prices | Positive | Anderson and Seijo 2010; NPFMC/NMFS 2016; Interviews |
| Harvest (Lbs.) | Food/Nutrition | Positive | NPFMC/NMFS 2016 |
| Harvest (Lbs.) | Gross Revenue | Positive | Anderson and Seijo 2010; NPFMC/NMFS 2016 |
| Harvest (Lbs.) | Large Adults | Negative | Hanselman et al. 2019 |
| Harvest (Lbs.) | Local Food Security | Positive | Carothers 2010; Carothers 2015; Ringer et al. 2018; Szymkowiak and Kasperski, *forthcoming* |
| Harvest (Lbs.) | National Food Security | Positive | Szymkowiak and Kasperski, *forthcoming* |
| Harvest (Lbs.) | Small Adults | Negative | Hanselman et al. 2019 |
| Highgrading/ Discarding | Average Fishing Costs | Positive | NPFMC 2018; NPFMC 2019; NPFMC 2019b; Interviews |
| Highgrading/ Discarding | Average Price | Positive | NPFMC 2018; NPFMC 2019; NPFMC 2019b; Interviews |
| Highgrading/ Discarding | Connection to Ecosystem | Negative | NPFMC 2018; Interviews |
| Highgrading/ Discarding | Education/ Information | Negative | NPFMC 2018; NPFMC 2019; NPFMC 2019b; Interviews |
| Highgrading/ Discarding | Food/Nutrition | Negative | NPFMC 2018; NPFMC 2019; NPFMC 2019b; Interviews |
| Highgrading/ Discarding | Governance/ Management | Negative | NPFMC 2018; NPFMC 2019; NPFMC 2019b; Interviews |
| Highgrading/ Discarding | Large Adults | Negative | NPFMC 2018; NPFMC 2019; NPFMC 2019b; Interviews |
| Highgrading/ Discarding | Local Food Security | Negative | Interviews |
| Highgrading/ Discarding | Mental Health | Negative | Interviews |
| Highgrading/ Discarding | National Economy | Negative | NPFMC 2018; NPFMC 2019; NPFMC 2019b |
| Highgrading/ Discarding | National Food Security | Negative | NPFMC 2018; NPFMC 2019; NPFMC 2019b |
| Highgrading/ Discarding | Physical Health | Negative | Interviews |
| Highgrading/ Discarding | Resilience | Negative | NPFMC 2019b; Interviews |
| Highgrading/ Discarding | Self Determination | Negative | Interviews |
| Highgrading/ Discarding | Sense of Community | Negative | Interviews |
| Highgrading/ Discarding | Sense of Enjoyment/Fulfillment | Negative | Interviews |
| Highgrading/ Discarding | Small Adults | Negative | NPFMC 2018; NPFMC 2019; NPFMC 2019b; Interviews |
| Highgrading/ Discarding | Stewardship | Negative | NPFMC 2018; NPFMC 2019; NPFMC 2019b; Interviews |
| Highgrading/ Discarding | Sustainability | Negative | NPFMC 2019b; Interviews |
| IFQ Leasing | Average Fishing Costs | Negative | Szymkowiak and Himes-Cornell 2015; Szymkowiak and Felthoven 2016; Interviews |
| IFQ Leasing | Consolidation | Positive | NPFMC/NMFS 2016; Szymkowiak and Himes-Cornell 2017; Interviews |
| IFQ Leasing | Lease Fees | Negative | NPFMC/NMFS 2016; Interviews |
| IFQ Leasing | Sense of Community | Negative | Ringer et al. 2018; Interviews |
| IFQ Leasing | Social Justice & Equity | Negative | Ringer et al. 2018; Interviews |
| IFQ Stacking | Average Fishing Costs | Negative | NPFMC 2013; NPFMC 2015; Szymkowiak and Himes-Cornell 2015; Interviews |
| IFQ Stacking | Consolidation | Positive | NPFMC 2013; NPFMC 2015; Interviews |
| IFQ Stacking | Gear Conflicts | Positive | NPFMC 2013; NPFMC 2015; Interviews |
| IFQ Stacking | Sense of Community | Positive | Interviews |
| IFQ Stacking | Stewardship | Positive | Interviews |
| IFQ Stacking | Whale Depredation | Negative | NPFMC 2013; NPFMC 2015; Interviews |
| Large Adults | Average Fishing Costs | Negative | NPFMC 2018; NPFMC 2019; NPFMC 2019b; Interviews |
| Large Adults | Average Price | Positive | NPFMC 2018; NPFMC 2019; NPFMC 2019b; Interviews |
| Large Adults | Avoidance Behavior | Negative | NPFMC 2018; NPFMC 2019; NPFMC 2019b; Interviews |
| Large Adults | Fisheries Participation (Effort) | Positive | Rosellon-Druker, *forthcoming*; Interviews |
| Large Adults | Food/Nutrition | Positive | Hanselman et al. 2019 |
| Large Adults | Harvest (Lbs.) | Positive | Rosellon-Druker, *forthcoming*; Interviews |
| Large Adults | Local Food Security | Positive | Interviews |
| Large Adults | National Food Security | Positive | Hanselman et al. 2019 |
| Lease Fees | Physical Safety | Negative | Szymkowiak and Himes-Cornell 2015; Interviews |
| Lease Fees | QS Prices | Positive | Anderson and Seijo 2010; Szymkowiak and Felthoven 2016; Interviews |
| Lease Fees | Sense of Community | Negative | Ringer et al. 2018; Interviews |
| Lease Fees | Social Justice & Equity | Negative | Ringer et al. 2018; Interviews |
| Lease Fees | Stewardship | Negative | Szymkowiak and Himes-Cornell 2015; Szymkowiak and Himes-Cornell 2017; Interviews |
| Livelihood | Fisheries Participation (Effort) | Positive | Anderson and Seijo 2010; Interviews |
| Non-target Bycatch | Connection to Ecosystem | Negative | NPFMC 2015; Interviews |
| Non-target Bycatch | Education/ Information | Negative | NPFMC 2019c; Echave and Hulson 2019; Interviews |
| Non-target Bycatch | Food/Nutrition | Negative | NPFMC 2019c; Echave and Hulson 2019; Interviews |
| Non-target Bycatch | Governance/ Management | Negative | NPFMC 2019c; Echave and Hulson 2019; Interviews |
| Non-target Bycatch | Local Food Security | Negative | Interviews |
| Non-target Bycatch | Mental Health | Negative | Interviews |
| Non-target Bycatch | National Food Security | Negative | NPFMC 2019c; Echave and Hulson 2019 |
| Non-target Bycatch | Resilience | Negative | Interviews |
| Non-target Bycatch | Sense of Community | Negative | Interviews |
| Non-target Bycatch | Sense of Enjoyment/Fulfillment | Negative | Interviews |
| Non-target Bycatch | Stewardship | Negative | Interviews |
| Non-target Bycatch | Sustainability | Negative | Interviews |
| QS Prices | Consolidation | Positive | NPFMC/NMFS 2016; Interviews |
| QS Prices | Cultural Values & Traditions | Negative | Carothers 2010; Carothers 2015; Ringer et al. 2018 |
| QS Prices | Education/ Information | Negative | Carothers 2010; Carothers 2015; Ringer et al. 2018 |
| QS Prices | Personal Development | Negative | Carothers 2010; Carothers 2015; Ringer et al. 2018 |
| QS Prices | Resilience | Negative | Carothers 2010; Carothers 2015; Ringer et al. 2018 |
| QS Prices | Sense of Community | Negative | Carothers 2010; Carothers 2015; Ringer et al. 2018 |
| QS Prices | Social Justice & Equity | Negative | Carothers 2010; Carothers 2015; Ringer et al. 2018 |
| Small Adults | Average Fishing Costs | Positive | NPFMC 2018; Interviews |
| Small Adults | Average Price | Negative | NPFMC 2019; Interviews |
| Small Adults | Avoidance Behavior | Positive | NPFMC 2018; NPFMC 2019b; Interviews |
| Small Adults | Connection to Ecosystem | Negative | Interviews |
| Small Adults | Fisheries Participation (Effort) | Negative | NPFMC 2018; Interviews |
| Small Adults | Food/Nutrition | Negative | Hanselman et al. 2019 |
| Small Adults | Harvest (Lbs.) | Positive | Hanselman et al. 2019; Interviews |
| Small Adults | Highgrading/ Discarding | Positive | NPFMC 2018; NPFMC 2019; NPFMC 2019b; Interviews |
| Small Adults | Large Adults | Positive | Hanselman et al. 2019 |
| Small Adults | Lease Fees | Negative | Interviews |
| Small Adults | Local Food Security | Negative | Interviews |
| Small Adults | Mental Health | Negative | Interviews |
| Small Adults | National Food Security | Negative | Interviews |
| Small Adults | Political Participation | Positive | Interviews |
| Small Adults | QS Prices | Negative | Anderson and Seijo 2010; Interviews |
| Whale Depredation | Average Fishing Costs | Positive | Hanselman et al. 2019; Interviews |
| Whale Depredation | Avoidance Behavior | Positive | Peterson and Carothers 2013; Peterson et al. 2014; Interviews |
| Whale Depredation | Connection to Ecosystem | Negative | Peterson and Hanselman 2017; Interviews |
| Whale Depredation | Fisheries Participation (Effort) | Positive | Peterson et al. 2014; Interviews |
| Whale Depredation | Food/Nutrition | Negative | NPFMC 2015; Interviews |
| Whale Depredation | Governance/ Management | Negative | Peterson and Hanselman 2017; Interviews |
| Whale Depredation | Harvest (Lbs.) | Negative | Peterson and Hanselman 2017; Hanselman et al. 2019; Interviews |
| Whale Depredation | IFQ Stacking | Positive | Hanselman et al. 2019; NPFMC 2013; NPFMC 2015; Interviews |
| Whale Depredation | Income Security | Negative | Peterson and Carothers 2013; Peterson et al. 2014; Interviews |
| Whale Depredation | Large Adults | Negative | Peterson and Hanselman 2017; Hanselman et al. 2019; Interviews |
| Whale Depredation | Local Food Security | Negative | Interviews |
| Whale Depredation | Mental Health | Negative | Interviews |
| Whale Depredation | Physical Safety | Negative | Interviews |
| Whale Depredation | Political Participation | Positive | NPFMC 2013; NPFMC 2015; Interviews |
| Whale Depredation | Self Determination | Negative | NPFMC 2013; NPFMC 2015; Interviews |
| Whale Depredation | Sense of Enjoyment/Fulfillment | Negative | NPFMC 2013; NPFMC 2015; Interviews |
| Whale Depredation | Small Adults | Negative | Peterson and Hanselman 2017; Hanselman et al. 2019; Interviews |
| Whale Depredation | Stewardship | Negative | Interviews |