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Adaptations and well-being: Gulf of Alaska fishing families in a changing landscape

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ABSTRACT

Over the last three decades, fishing families in the Gulf of Alaska have adapted to numerous multifaceted conditions in response to near constant flux in stocks, markets, governance regimes, and broader sociocultural and environmental changes. Based on an analysis of seven focus groups held across Gulf of Alaska fishing communities, this study explores the variety of strategies that families across the Gulf have employed to adapt to changing conditions from the 1980s to the present day. Furthermore, the study examines how those strategies have evolved over time to accommodate cumulative effects and synergisms. While families continue to employ long-standing adaptation strategies of fisheries portfolio diversification and increasing effort, they are also integrating new adaptations into their framework as changing management systems, demographics, and technologies shift how choices about adaptations are made. This study also demonstrates how adaptations have implicit intra- and inter-personal well-being tradeoffs within families that, while potentially allowing for sustained livelihoods, may undermine other values that individuals and families derive from fishing.

1. Introduction

Social systems and social change modulate human interactions with ecosystems and mediate ecological impacts (Kittinger et al., 2012). People’s capacity to adapt to social and ecological changes implies that these systems need to be considered dynamic. In turn, the existence of diversity in adaptation strategies, how that diversity is distributed or patterned, has implications for the ultimate resilience of social-ecological systems and the well-being of individuals, families, and communities (Leslie et al., 2013).

Commercial fishing is a highly risky occupation subject to spatial and temporal variability across multiple social and ecological dimensions (Kasperski and Holland, 2013). Across the world, fisheries are changing more rapidly than in the past in response to the increased pace of ecological, technological, market, and other socioeconomic shifts, necessitating more rapid response and varied adaptations (Allison et al., 2009; Cheung et al., 2010; Hobday and Pecl, 2014; Pecl et al., 2017). Researchers have shown that understanding the importance of the family unit as responsive to changing conditions is central to developing effective policies that facilitate adaptation (Neis, 1999; Zvonkovic, McGraw, and Manoogian-O’Dell, 2000; Zhao et al., 2013; Pettersen, 2018). Yet the research on the role that the family unit has in adaptive choices and how those choices in turn affect individual and family well-being is fragmented and largely responsive to specific changes in fishery conditions, i.e. catch share implementation, stock and price declines (Durrenberger, 1997; Mederer, 1999; Mederer and Barker, 2000; Zvonkovic, McGraw, and Manoogian-O’Dell, 2000; Conway et al., 2002; Marks, 2012), with some notable exceptions that focus on longer term family evolution (Endter-Wada and Keenan, 2005; van Ginkel, 2014) and the central role of women in providing adaptive capacity (Munk-Madsen, 1998; Binkley, 2000; Britton, 2012; Calhoun et al., 2016).

Unlike businesses or firms structured to maximize profits, commercial fishing families are often organized around non-economic household concerns and family interests with shared work structures that may allow them to more readily adjust to lean fishing times (Doeringer et al., 1986; Durrenberger, 1994; Munk-Madsen, 2000; Marks, 2012). The reserve of labor coupled with pooled economic, cultural, and knowledge resources may allow fishing families a degree of adaptability that is not readily replicated in other contexts (Durrenberger and Palsson, 1985; Doeringer et al., 1986; Marks, 2012; van Ginkel, 2014). Fishing families often operate in terms of expenses and income rather than wages and profits, moving resources like labor and capital fluidly in response to...
expansions and contractions, a versatility that can be critical for survival in lean times (Durrenberger, 1997; Munk-Madsen, 2000; Marks, 2012).

Although adaptations may mitigate adverse livelihood effects of fisheries downturns, they may also be associated with implicit tradeoffs in other well-being components (e.g., family connection, physical safety). A fisherman may go out further to sea to adjust to decreasing nearshore catches, which may attenuate diminishing earnings, but in turn increase safety risk and time away from family (Criddle, 2012, Suckall et al., 2014; Coulthard and Britton, 2015). The balance of well-being components with adaptation strategies is going to be determined by the freedom and agency of individuals in terms of choosing whether and how to adapt (Coulthard, 2012). Yet, families are comprised of multiple individuals and even within families making unified adaptation choices there are likely to be both intra-personal tradeoffs on different components of well-being and inter-personal tradeoffs between the well-being of various actors (McGregor et al., 2015; Coulthard and Britton, 2015).

The following study examines commercial fishing family characteristics and adaptation strategies to changing fishery conditions in Gulf of Alaska fishing communities. The Gulf of Alaska has been identified as one of the sentinels for ecosystem change in the world, where ocean warming is occurring fastest and where temperature anomalies associated with marine heat waves have already greatly undermined some fisheries (Hobday and Pec, 2014; Barbeaux et al., 2019 Walsh et al., 2018). For example, in response to unprecedented low numbers of Pacific cod the Gulf of Alaska federal directed cod fishery will be closed in 2020 (NPFMC 2020) At the same time large-scale technological disasters and price shocks, including the Exxon Valdez Oil Spill and the decline of salmon prices following the introduction of farmed salmon, as well as the implementation of increasingly complex management regimes in the region have affected when, where, and how people participate in fisheries (Picou et al., 1992; Carothers, 2010; Carothers and Chambers, 2012; Knapp, 2013; Hebert, 2015). Thus fishing families in the area have been grappling with multifaceted change for decades and the ways in which they have applied and modified their adaptation strategies over that timeframe can inform a broader understanding of how fishing communities may adapt to change elsewhere. Furthermore, this study illuminates factors that contribute to choices about adaptive strategies and the well-being tradeoffs associated with these strategies, providing a context for understanding how adaptations and associated well-being may be distributed within and across communities.

2. Methods

Information about commercial fishing family characteristics, dynamics, and responses to changing conditions was garnered from discussions held during focus groups from June 2017 to September 2018 across the seven largest fishing communities in the Gulf of Alaska in terms of revenues and number of vessels: Anchorage, Cordova, Homer, Juneau, Kodiak, Petersburg, and Sitka. This research is specific to commercial fishing families in the harvesting sector, and similar dynamics could be explored separately for processing families. The focus groups were intended to provide a venue for a facilitated discussion of three key topic areas: (1) fishing family roles and gender divisions of labor; (2) impacts of management, environmental, economic, and social conditions on fishing family dynamics; and (3) the future of fishing families and women in Alaska fisheries. These focus groups also illuminated patterns in women’s participation in fishing families and Alaska fisheries more broadly, which are presented in Szymkowiak (2020).

The first discussion topic focused on perceptions of family roles and responsibilities in Alaska fisheries, wherein participants were asked to define a fishing family and the inherent characteristics of those families. The intent of discussing the characteristics of fishing families as the initial discourse of the focus groups was two-fold. First, it contextualized the remainder of the focus group discussion within a broader framework of various components of well-being (Breslow et al., 2016) because the characterization of fishing families enveloped numerous components – livelihood, identity, family connection, sense of community, etc. Second, by initiating the conversation with a simple question about “what is a fishing family”, it empowered participants with wholly providing the language for defining those characteristics and reduced researcher bias in informing that process. In addition, allowing participants the autonomy to fully frame their own fishing family attenuates academic pursuits of “central tendencies”, which have been noted by others (Ellis, 1984). In utilizing focus group methods, this research provides that participants inherently speak to their own experiences and identities in ways that encompass variability not as divergence from the mean but as variations of themes that are largely discussed with respect to their congruence. This was further ensured within this research through emphasis on a diversity of perspectives, wherein participants were asked to not repeat themes unless they disagreed with something that was said, but to speak to their individual experiences of thematic areas.

The second discussion topic focused on fishing family dynamics and adaptation strategies to regulatory, environmental, social, and economic changes. The intent of this topic was to examine the changing conditions that Alaska fishing families have responded to and the strategies they have employed to adapt to those conditions. Participants were given a memory aid – a timeline of major events in Alaska’s fisheries from 1900 to the present day (see supplementary materials) – which was conducted as an individual exercise prior to group discussion. This exercise helped to facilitate the discussion and tap into social memory and cultural heritage (Nadel-Klein, 2003; Coulthard, 2005; Britton, 2012), while providing participants with a way of framing their experiences that is less subject to group dynamics and censoring (Kidd and Parshall, 2000; Carey, 2016). These responses were also analyzed and incorporated into the overall results on fishing family dynamics and changing conditions.

The third discussion topic focused on expectations about future shifts in the relevant socio-ecological system and how participants envisioned adapting to those circumstances, given their experiences in the past. This discussion was often highly integrated with that of the second discussion topic and elucidated how adaptation strategies may need to evolve to accommodate rapidly changing conditions and how fishing families are responding to increased uncertainty about the landscape within which they operate.

A maximum variation sampling design was implemented, which targeted study sites and participants across specified criteria to understand fishing family dynamics and adaptations across a broad spectrum of experiences (Creswell and Poth, 2018). The seven fishing communities were selected on the basis of their high fisheries engagement and participation across a variety of fisheries, with differing historical contexts of changing fishery conditions and participation. Key informants were identified for the focus groups across a number of criteria, including gender, age, years of fishing experience, family contexts, and target fisheries (Tremblay, 1957; Krueger and Casey, 2004). The focus groups were also advertised with local fishing associations and organizations, which helped to identify and solicit potential participants. However, because these were effectively public meetings, the sample was not fully under the control of the researcher. A total of 102 participants attended the focus groups, participating across at least 20 distinct fisheries (although the actual total is likely to be much greater due to gear and area distinctions that are not readily demarcated from the discussions), with an estimated age range of 15–70 and an average of 45 (as ages were not directly solicited), with a total of 59 women across the focus groups. Fig. 1 provides the geographic, demographic, and fishery distribution of the focus group participants. Many focus group participants participate in multiple fisheries and some were fishing representatives or managers that did not indicate activity in any fishery.

The focus groups lasted 2 h each, with process agendas and interview guides based on open ended topics to elicit spontaneous and multi-layered responses (Kidd and Parshall, 2000; Krueger and Casey, 2014). In addition to the timeline exercise described above, participants were provided with handouts for additional feedback for each topic.
Major themes for each topic were summarized on flip charts posted at the front of the room, which allowed participants to reflect on the full discourse of each topic area while the conversation continued and for the researcher to track data saturation points on each topic. The major themes and related discussions were summarized for each focus group and provided to participants via email for further feedback allowing them the opportunity to challenge any interpretations by the researcher and to provide further explanations. The focus group discussions were recorded with the informed consent of the participants and transcribed verbatim. Transcribed discussions were entered into MAXQDA, a qualitative data analysis program, and thematically coded using grounded theory (Strauss and Corbin, 1990).

Focus groups provide a means of conducting robust research across multiple, geographically isolated communities (as in the Gulf of Alaska) when resources such as time and capital for travel are limited (Szymkowiak and Rhodes-Reese, 2020). Furthermore, in facilitating a wider geographic scope for research, focus groups can also provide for inter-community comparisons and examining conceptual reliability in thematic areas across the group discourse (Szymkowiak and Rhodes-Reese, 2020). In this case this was exemplified through examining the utilization of similar adaptation strategies across communities. Focus groups are a method for conducting participatory research that benefit from group discourse yielding results that could not be generated from individual interviews alone (Kidd and Parshall, 2000; Krueger and Casey, 2014), which have been employed in other contexts examining fishing families (Zvonekovic et al., 2005; Bene et al., 2007). In this study the group discussion allowed participants to identify both the commonality and divergence in the adaptation strategies that they employed in response to various conditions and the factors that may have contributed to any differences. Despite substantial variation in community sample sizes the overall sample is considered representative since the focus of this study is to understand the diversity of adaptation strategies that have been employed to a mixture of conditions that have differentially affected these communities.

3. Results and discussion

3.1. Exploring the characteristics of Alaska commercial fishing families

For exploratory purposes in initial data analysis, a word cloud was created of the top 100 words used by focus group participants to characterize fishing families that denote the frequency of usage by word size, (Fig. 2). (The colors in the figure are only an artistic rendering and do not represent any statistical aspects of the data). The foremost feature of a fishing family that emerged from this exercise was the social relationships, exemplified with the prominence of various words including kids, women, families, daughters, people, guys, role, dad, mom, wife, sons, husband, skipper, community, and men. The employment and physical dimensions that characterize families with respect to the fishing occupation are also notable in the word cloud, with boat, things, home, work, operation, and job all appearing with various frequency. The importance of the temporal landscape for fishing families is also conveyed with the time-related words (years, time, day). Although income and money both appear in the word cloud these words were used less frequently than most of the words that comprise the other dimensions noted above, which is aligned with previous findings that income may be less relevant for fishing identities and maintaining participation than other facets of the occupation (Durrenberger, 1997; Garcia-Quijano, 2009; Urquhart and Acott, 2014; Pascoe et al., 2015).

The overarching dimensions of fishing family characteristics that appear in the world cloud were consistent with thematic areas that emerged during the coding process for the focus group transcripts. The discussion of fishing families across the focus groups revealed four general areas that, according to participants, characterize fishing
families - culture and identity, livelihood, social relationships, independence and resilience. Fig. 3 shows these overarching characteristics as well as specific components of those characteristics (each of which are described in more detail below). The characteristics denoted were homogenous across focus group participants, irrespective of their target fisheries and communities.

According to focus group participants, fishing families are characterized by a number of salient features: (1) economic dependence on fishing (to various degrees); (2) independence and resilience in the face of high variability and risk; (3) a sense of self (individual and family) and community tied to fisheries that is propagated through generations and that permeates everyday life, and (4) social relationships built upon the common experience of fishing and its associated risks.

The characteristics of fishing families highlighted by focus group participants are implicitly intertwined and inherently synergistic. Fishing families, as described by focus group participants, are structured around the unpredictability and seasonality of fisheries, which necessitate both a flexible reserve labor pool and near constant scheduling accommodations (Endter-Wada and Keenan, 2005). The ways in which fishing families manage their operations, with fluidity and adaptability implies that all family members have a role in the operation (Durrenberger, 1997; Endter-Wada and Keenan, 2005; Marks, 2012). This
structure helps to in turn build a family value system that affects everything from daily activities to child rearing philosophies (Conway et al., 2002; Endter-Wada and Keenan, 2005; Marks, 2012). These dynamics contribute to personal and family identities that are structured around fishing as a way of life rather than an occupation and include a sense of pride associated with demonstrable family resilience, especially in the face of high risk and variability (Ellis, 1984; Davis, 1986; Palsson, 1989; Smith and Jepson, 1993; Mederer, 1999; Britton, 2012; Calhoun et al., 2016). In turn, families build deep connections internally and with other fishing families in their community upon which they rely for support in the face of financial and emotional adversity (Davis, 1986; Smith and Jepson, 1993; Conway et al., 2002; Garcia-Quijano, 2009).

Participants described fishing as a way of life providing a rhythm around which families are structured, from daily life to seasonal transitions. Even for those in the family that do not actively participate in fishing, their lives are often deeply embedded in it, from providing logistical support to planning family life around the fishing seasons. A focus group participant described how deeply this rhythm may sometimes be internalized by family members in relation to her son’s understanding of seasons:

“He was five years old, been fishing since he was two, like I said, and he came home with homework from school and it was a picture of the seasons: summer, winter, fall, you know, spring. And, he was looking at that piece of paper, and he’s five, and he says, ‘mom I don’t get it.’ It said write down what season it is. And I said, ‘you know what the seasons are’, and he said ‘you mean crab, halibut, salmon and herring?’”

(Kodiak participant)

Participants described how fishing is often at the center of family organization and provides the setting for interactions through which identities are created and meanings are constructed (Mederer, 1999). According to participants, fishing families are defined by their work and how it shapes each generation within their family, instilling values early in children that are deeply ingrained in the occupation, including building a work ethic, a sense of responsibility in helping the family, and discipline. Children are given tasks to perform early on in life that are tied to the success of the fishing operation and thus learn the value of their contribution and how the family unit relies and benefits from each member. Because of the extensive time and isolation that are often associated with fishing, families are afforded the opportunity to build deep connections through learning about each other and how to work together.

“Everyone, no matter how old you are, you have some role to play and that role is important to the success to the operation and I think that is what is so important when you are thinking about what a fishing family does.”

(Kodiak participant)

Participants discussed a deep sense of pride in their family fishing identity, which is rooted in the independence and agency with which they make a living that researchers note may be difficult to replicate in other occupations (Pollnac and Poggie, 2008; Bavinck et al., 2012; Coulthard and Britton, 2015). A key dimension of this sensibility is the perceived lack of a social safety net to buffer against hard times in terms of government income insurance programs, which in turn necessitates inherent resilience in the family structure. In contrast, the importance of intra-community buffers was discussed in several communities with respect to the presence of social capital or networks of fishermen and fishing families that, as elsewhere, serve to facilitate life for each other (Dasgupta, 2005; Bodin; Crona, 2009; Ramirez-Sanchez and Pinkerton, 2009; Holland et al., 2019).

Fishing families may be defined by a set of characteristics that are exceptional to households where occupational responsibilities may be shared, which provide for unique opportunities to shape identities, children, and bonds. However, focus group participants also described how these families are subject to exceptional risks, constant adjustments, and often prolonged periods of separation which may both define them as different from non-fishing families (Endter-Wada and Keenan, 2005) as well as stress these bonds and identities. A fishing family’s reliance on a resource subject to variability in abundance and value puts it inherently at risk of income fluctuations, with an associated sense of uncertainty that is inherently stressful. Fishing families are also in frequent transitions imposed by the departure and arrival of the predominant fishing participant in the household. Both periods are marked by a certain upheaval and necessitate renegotiation of roles and responsibilities, power dynamics and decision making, and family membership more broadly (Mederer and Barker, 2000). The family’s capacity to fluidly respond to different situations over the course of a day, fishing season, or year seem to build a sense of functionality that underlies its comradery.

The deeply rooted personal identity of fishermen and fishing families coupled with a sense of resilience that, as discussed above, may be integral to that identity can make fishing families reluctant to exit fishing even in the face of diminishing returns and multifaceted adverse conditions (Bavinck, 2001; Nadel-Klein, 2003; Pollnac; Poggie, 2008; Marks, 2012; van Ginkel, 2014). Rather, families seem to adopt a variety of often synergistic strategies intended to mitigate financial loss, provide stability for household incomes and family dynamics, and ensure the viability of their fishing operations and family fishing identities in the long-run.

“fishing is a lifestyle and you have to decide that’s the lifestyle that you want to do ... the price of getting into a fishery has always fluctuated over history, whether it’s quotas or salmon permits or whatever ... if you want the lifestyle, you’re going to have to pay attention to where you put your money and what you are going to get for a return.”

(Homer participant)

3.2. Changing conditions and evolving adaptation strategies

This section focuses on adaptations to conditions that were perceived as adverse by focus group participants, which dominated the discourse during the discussions. Nevertheless, it should be noted that some participants also discussed the benefits of certain changes in Alaska’s fisheries, including catch share programs and hatchery fish production, in terms of providing stability, predictability in business planning, and safety improvements that allowed for inter alia product quality improvements, operational expansion, and integrating broader family participation onboard fishing vessels. The discussion of changing conditions begins with the late 1970s, aligned with the representativeness of the majority of the collective memory at the focus groups.

3.2.1. Changing conditions in Alaska’s fisheries

Over the last three decades, focus group participants noted that fishing families in Alaska have evolved their adaptation strategies in response to a multitude of novel, increasingly complex and synergistic fishery conditions (Table 1). The descriptions of the conditions and strategies in Table 1 are provided in terms of the primary ways in which they were discussed by focus group participants. Most conditions affected participants throughout the study period to varying degrees. For example, changes in prices were discussed in terms of large declines (e.g., price shocks in the 1990s following the introduction of farmed salmon into the global fish market) as well as continued year-over-year variability and uncertainty. Because most of these conditions recur over time they are not associated with a specific timeframe. However, some events like the Exxon Valdez oil spill in 1989 and the institution of specific limited access privilege programs (LAPPs) – limited entry and
Table 1
Changing conditions in Alaska fisheries and adaptation strategies discussed by focus group participants.

| Conditions | Description | Conditions | Description |
|------------|-------------|------------|-------------|
| Exxon Valdez Oil Spill (EVOS) (1989) | - Associated effects on stocks and prices | Fish prices | - Variability/uncertainty |
| Management | - Regulations - instability, season lengths, area closures, insurance/safety/child labor regulations, reallocations, complexity | Fishing costs | - Decreases |
| | - Science - models/stock assessments, complexity, mistrusts | | - Boats, gear, operating |
| Fish Stocks | - Variability/uncertainty | Sociocultural Factors | - Drugs, work ethic, technology, demographics, cultural norms |
| Limited Access Privilege Programs (LAPPs) | - Decreases | Entry costs (permits and quota shares) | |
| | - Catch share and limited entry programs, in particular limited entry in State salmon fisheries (beginning in 1973) and the Pacific halibut and sablefish Individual Fishing Quota (IFQ) Program in 1995. | | |

Catch share programs - with distinct timestamps were discussed effectively as regime shifts in how people participate in Alaska fisheries. The implementation of LAPPs in Alaska began in the 1970s with limited entry permit programs in State salmon fisheries and has continued over the decades to include catch share programs in federal fisheries, beginning with the Pacific halibut and sablefish Individual Fishing Quota (IFQ) Program in 1995. The institution of a variety of Limited Access Privilege Programs (LAPPs) has limited fishery diversification opportunities and increased entry costs while other management regimes have curtailed when, where, and how families can fish. The volume of management actions that affect fishing families, inclusive not just of fishery-specific regulations like LAPPs but those dealing with safety requirements, insurance, and child labor provisions has also increased according to focus group participants. Furthermore, intricate management systems are coupled with increasingly complex scientific models underpinning stock assessments and perceived ecosystem changes from marine heat waves and climate change more broadly, leaving fishing families feeling heightened uncertainty and anxiety about their futures.

“Markets are going to go up and down; stocks are going to go up and down. Those are risks that we know and understand. I learned them since I was old enough to understand English. That I can handle. What I can’t is when somebody comes up with a brand-new model that doesn’t let you access the resource. Or if it is like we are going to reallocate, that would be a problem.”

(Petersburg participant)

“you have uncertainty about the price of fish, uncertainty about the stocks you are dependent on whether it’s going to be high or low. But I also think we have the added uncertainty about climate change and what how’s that going to affect things. Typically we’re on a little bit of variability up and down, but then we have cod go down by 80% in one year and they blamed it on the Blob… there is going to be more of those types of events in the future which means as a fishing family you are going to have more uncertainty about the revenue you are going to generate.”

(Kodiak participant)

The ways in which changing conditions manifest themselves, as described by focus group participants, have different temporal and spatial dimensions necessitating both a variety and the coupling of adaptation strategies. For conditions that have defined timestamps, such as the Exxon Valdez oil spill (EVOS), some of the resultant changes like fishery closures were immediate and required instantaneous response. Other conditions are somewhat bounded spatially, like the crash of the red king crab fishery around Kodiak and EVOS, where the effects were described similarly to that of an earthquake with a distinct epicenter and lessening intensity as one moves towards the periphery. Some conditions have substantial inter-annual variation (like stocks and prices) and/or an evolutionary component (LAPPs, management effects, costs, sociocultural factors) necessitating strategies that respond to different temporal dimensions. Ultimately, some conditions have effects that may transpire over the course of multiple years (e.g., the rising costs of entry associated with LAPPs) and many conditions have coupled synergistic or multiplicative effects (e.g., the decline of salmon prices occurred immediately following EVOS, leaving many families with few opportunities to generate fishing income).
3.2.2. Adaptation strategies utilized by focus group participants

The strategies employed by focus group participants in response to the diversity of aforementioned changing conditions in Alaska fisheries are demonstrated in the chord diagram (Fig. 4). The thickness of the lines denotes the frequency with which the strategies were noted in the context of a specific condition. The colors are intended to facilitate interpretation of the figure with respect to which adaptations were employed in response to each condition, with each condition having its own designated color. The focus group discourse was not intended to provide an exhaustive list of strategies that each family employed to address each type of condition. Rather, it points to the diversity of strategies employed and potentially the ones participants believed were most critical in addressing any potential adversities.

Modification of fishing behavior with increased effort, fisheries diversification, and decreasing operating costs were noted as the most well-established strategies that were employed by fishing families throughout Gulf of Alaska communities to address changing conditions. Participants noted that increasing effort by fishing harder, going out further to sea, staying out longer, and investing in larger vessels are common responses to fishing revenue declines, as elsewhere (Binkley, 1996; Durrenberger, 1997; Marks, 2012; Costello, 2017). These strategies are particularly applicable in response to inter-annual variation in spatial distributions of fish and localized depletion and to decreases in dockside prices when harvests are not constrained by individualized quotas. As such, the strategies were indicated by focus group participants to be within the standard portfolio of responses that fishermen have historically utilized to adapt to conventional shifts in conditions – that is, stock and price variability.

Fisheries diversification, in terms of for example targeting various species, in multiple areas, has also been widely utilized by Alaska fishing families to mitigate income variability in response to inter-annual variation in stock abundance and prices. This is a commonly employed strategy by fisheries participants around the world and has had demonstrable efficacy in decreasing variation in revenues and increasing economic resilience (Binkley, 1996; Hilborn et al., 2001; Endter-Wada and Keenan, 2005; Kasperki and Holland, 2013). However, focus group participants and researchers alike note the decreasing opportunities for diversification in Alaska fisheries over time due to the implementation of LAPPs and associated increases in the costs of entering a fishery (Kasperki and Holland, 2013; Beudreau et al., 2019). Other dimensions of diversification strategies noted by focus group participants included leasing fishing access or harvest privileges and working as crewmembers or skippers on someone else’s vessel (Szymkowiak and Himes-Cornell, 2015).

Fig. 4. Coupled adaptations to changing conditions derived from focus group discussions. The thickness of the lines represents the extent to which the adaptation strategy was employed in response to each condition. The coloration is intended to facilitate interpretation with each condition having its own associated color. Chord diagram created using the R package “Circlize” (Gu, 2014). (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)
Fishing families also address inter-annual revenue variation by decreasing operating costs. Focus group participants largely discussed replacing paid crewmembers with household family members who do not ostensibly require payment as a way of mitigating costs. Family fishing operations have been noted in other contexts to be fluid and flexible, pooling resources and adjusting to expansions and contractions with a reserve labor pool that may be used to replace a paid crewmember in response to decreasing revenues (Durrenberger; Palsson, 1985; Doeringr et al., 1986; Binkley, 1996; Grzetich, 2004; Munk–Madsen, 2000; Power, 2005; Marks, 2012).

The focus group discussions indicated that other strategies including increasing value, pluriactivity (diversifying household income), and exit, which have been used to adapt to inter-annual revenue variation from stocks or prices in the past in the region, have grown in frequency of application over time. The increasing utilization of these alternative strategies has been both in response to traditional changing conditions (stocks and prices) and new conditions emerging from broader sociocultural and management transformations (including LAPPs) as the other, more traditional, strategies like diversification have become increasingly constrained by management systems. In turn, focus group participants noted an increasing reliance on value-added strategies as technological developments have facilitated both fish quality improvements and marketing strategies that utilize improved Internet connectivity and the advent of social media to capitalize on shifts in consumer preferences towards products that demonstrate socio-ecological sustainability.

Pluriactivity, manifested through the generation of household income from multiple sources inclusive of fishing, was also noted as an increasingly employed strategy to provide financial security and buffer against uncertainties in fishing incomes (Salmi, 2005; Endter-Wada and Keenan, 2005; Marks, 2012; Blythe et al., 2014). Engaging in alternative forms of income generation can be undertaken by the member of the household who is the predominant fisherman, but was most frequently mentioned in the context of the other partner. As noted in other parts of the world, this means that pluriactivity in Alaska fishing families often manifests itself as the woman in the household engaging in shoreside employment, which in turn often necessitates renegotiations of traditional gender roles (Mederer, 1999; Binkley, 2000; Davis, 2000; Bates, 2006; Britton, 2012; Zhao et al., 2013).

The focus group discourse also revealed how exit strategies herein referring to a mixture of strategies that include geographic or occupational, temporary or permanent, fishery specific or general exit, have high degrees of fluidity and connectivity with other adaptations (Binkley, 1996; Marks, 2012). For example, temporary exit was regularly contextualized with pluriactivity, as in the case of responses to EVOS wherein some fishing families took a hiatus from fishing and engaged in other employment associated with the cleanup effort, in an attempt to remain in their geographic communities while awaiting the restoration of local fisheries (Picou et al., 2009). On the other hand, permanent exit from fisheries in response to other changing conditions (especially LAPPs) seemed often associated with concurrent geographic exit, as documented by researchers (Carothers, 2010; Donkersloot and Carothers, 2017; Ringer et al., 2018). This may reflect how identities and sense of place may be intrinsically linked to the fishing occupation for some Alaska communities, so that ceasing to participate in fisheries would imply the loss of a connection to the place itself and thus potentially necessitate geographic exit as well (Carothers, 2010; Holen, 2014; Himes-Cornell and Hoedting, 2015).

Other adaptation strategies seem to be more directly tied to conditions that have largely emerged from changing management regimes and associated complexities, inclusive of but not limited to LAPPs. Focus group participants noted increasing participation in the political process, as individuals, families, or through larger fishing associations, in response to a need to both understand and try to advocate for the family fishing operation within a constantly changing management system. One participant in Homer noted their increased political participation in terms of the adage “if you’re not at the table, you’re on the table” particularly in reference to LAPPs. Participation in policymaking by attending meetings, providing testimony, and serving on management councils may be an important strategy for fishing families to feel some control of the management process in response to changing conditions, although it is not always coupled with a sense of efficacy in affecting policy (Smith and Jepson, 1993; Mederer, 1999).

Specialization, in terms of concentrating fishing effort in one fishery, area, or species, can manifest itself as investing in more specialized equipment or quota shares and/or divesting of other fishing access or harvest privileges. Focus group discourse revealed that this strategy was heavily associated with LAPPs in particular (Hentati-Sundberg, 2015; Holland et al., 2017). The institution of the Pacific halibut and sablefish IFQ Program (IFQ Program) in 1995 was associated by many focus group participants with a loss of harvesting opportunities due to the allocation of very small amounts of quota shares that were not economically worthwhile to fish (Knapp, 1997; Carothers, 2013). In the salmon fisheries, the institution of limited access permits included a constraint on the total number of commercial limited entry salmon permits that can be owned and utilized by an individual, effectively necessitating specialization in one type of salmon permit (which are generally area- and gear-specific) (AS 16.43.140). Interestingly, some participants noted that the implementation of the IFQ Program actually provided for greater diversification opportunities for them as the prolonged fishing season no longer conflicted with the season for their primary target fishery (e.g., salmon), affording them the opportunity to participate in the federal halibut and sablefish fisheries as well.

Altered succession dominated the discourse across the focus groups, especially with respect to changes in management, the implementation of LAPPs, sociocultural factors, and costs. For the purposes of coding these focus group results, altered succession encompassed a number of interrelated and co-occurring themes including: changes to entry paths or patterns, no entry, intra-family transfers of harvest or access privileges, and loan structures and restructurings. For example, participants noted that sociocultural factors such as shifting values around work, increasing drug usage, and perceived stigmas surrounding the fishing industry coupled with regulations that in part prevent youth from working onboard fishing vessels (e.g. child labor laws and insurance liability issues) have stymied the growth of the next generation of fishermen. This has been exacerbated by increasing capital and operating costs of fishing along with perceived instability in management regimes including the possibility of reallocations and increasingly complicated scientific models underpinning harvest targets.

Relative to other changing conditions, the effects of LAPPs on altering and limiting succession in Alaska fisheries are perhaps the most well documented amongst the changes impacting entry and exit in Alaska fisheries (Carothers, 2010, 2013; Donkersloot and Carothers, 2017; Ringer et al., 2018). With permits and harvest privileges that have generally appreciated in value concurrent with losses in crew employment, coupled with delayed retirement due to increased safety and leasing of privileges, LAPPs have limited diversification opportunities and inhibited or altered entry for new participants around the world (Power, 2012; Neis and Power, 2013; van Ginkel, 2014; Szymkowiak and Himes-Cornell, 2015; White, 2015). Thus, traditional succession patterns of young family members and new participants gaining sufficient experience and capital to become vested in fisheries have changed with the new access structure, potentially impeding the capacity of the next generation of participants to be able to enter and expand their investment in fisheries (Donkersloot, 2005; Lowe, 2015; Donkersloot and Carothers, 2016; Ringer et al., 2018). Similar disconnects and inter-generational strife have been noted in other fisheries where Individual Transferable Quotas (ITQs) have disrupted multi-generational family fishing firms and adversely affected family and broader community relationships because of equity concerns (McCay, 1995; Olson, 2011; van Ginkel, 2014).
“I know lots of young people who would do just about anything to be successful … And there’s not an opportunity to buy a boat and go fishing right now, unless you have to go and buy a permit of some sort. You guys were talking about the salmon fishery and it’s not a corporate fishery but most people can’t live an entire year, a family on a salmon season. When you can’t have access to any other fisheries, then what are you going to do?”

(Kodiak participant)

3.2.3. Adaptations and their effects on well-being

One of the critical links between the impacts of adaptations on well-being is the extent to which a person has the freedom and agency to choose whether and how to adapt (Brown and Westway, 2011; Wolf, 2011; Coulthard, 2012). The focus group discourse revealed a number of factors that can constrain the adaptation strategies available to and thus employed by Alaska fishing families (Table 2) (which, similarly to conditions and adaptations, is not an exhaustive list but those that were noted in the discussions). Demographic variables coupled with well-being priorities (e.g., maintaining a fishing identity) were of paramount importance to the chosen strategy. For example, fisheries diversification was an adaptation most often noted by older participants who have both the historical context of relying on that strategy and (ostensibly) access to capital to buy additional permits. Pluriactivity and increasing value strategies were also associated with demographics in the discourse. Whereas older fishing participants revealed feeling largely constrained to continuing in fisheries, younger participants denoted a sense of greater occupational mobility (Marks, 2012). Similarly focus group discourse revealed that direct marketing is often a strategy employed by women, so that gender or marital/family status could also be included to explain adaptation choices. In part this may be borne out of competitive advantage, but focus group participants also discussed how autonomy related to access to capital and sociocultural factors coupled with a sense of fishing identity and well-being priorities (which may also be associated with demographics) affect adaptation choices.

“So, you’re either in it or you’re not. And a lot of kids choose not to be in it anymore because they kinda see the writing on the wall … but for those of us who are older and don’t have an education in anything but the fisheries. Where are you going to go when you are 50–60 years old? You stay, so you just move around.”

(Juneau participant)

The ultimate impacts of changing conditions on individual and family well-being were implied in the focus group discourse to be associated with not just the success of the adaptation in addressing the adverse impacts of the condition but the effects of the adaptation itself on other dimensions of individual and family life. Although the intent of adaptations is presumably to mitigate adverse livelihood effects from changing fishing conditions that are reducing fishing income, there are other dimensions that may be heterogeneously affected depending on the adaptation strategy and other underlying family dynamics. For example, increasing effort may imply going out further to sea, fishing longer and harder, which can result in heightened safety risks from fishing in unknown grounds with different hazards (strange tides, navigational obstacles, different sea bottoms), farther offshore in small vessels, and with insufficient rest periods (Binkley, 1996). A few focus group participants noted that these kinds of adaptations usually result in family members other than the primary fisherman staying onshore due to safety concerns. In turn, increased risk can cause stress and anxiety for fishermen and their families while lengthened periods of separation and resultant greater responsibilities for the onshore spouse can strain interpersonal familial relationships (Binkley, 1996; Zvonkovic, McGraw, and Manoogian-O’Dell, 2006; Coulthard and Britton, 2015). Although the extent of this stress is highly dependent on the structure of the family and how it normally operates (Mederer and Barker, 2000; Zvonkovic, McGraw, and Manoogian-O’Dell, 2006).

Understanding the nuances of adaptation effects across the components of well-being (Breslow et al., 2016) would necessitate a targeted inquiry at how those impacts may unfold across the family unit. What emerged from the focus group discussions, however, was the increasing necessity for families to adapt to changing conditions with a fundamental renegotiation of identities, relationships, and perspectives. According to participants, the increasing reliance on pluriactivity to buffer against variability in fishing income has largely resulted in women in fishing families engaging in shoreside employment and those wages often becoming the primary source of income and in turn sometimes subsidizing the fishing operation (Danowski, 1980; Maril, 1995; Binkley, 1996; Endter-Wada and Keenan, 2005). These sorts of shifts can be detrimental for men whose identity is tied to securing livelihood for their families and participation in the fishing industry (Lampl, 1986; Davis, 2000; Mederer, 1999; Smith et al., 2003; Sherman, 2009), and for women it can mean a tradeoff with other uses of their time and energy, including working on the family boat, child care, building social capital, etc. (Smith et al., 2003; Marks, 2012). However, focus group participants noted that often even as women in fishing families become the primary breadwinner, their other family responsibilities are not diminished and, as other researchers have noted, the net effect may be a subjugation of their personal well-being in exchange for that of their fishing family (Davis and Nadel-Klein, 1992; Binkley, 2002; Britton, 2012; Britton and Coulthard, 2013). In addition, women’s engagement in shoreside employment becomes critical in terms of not just maintaining household income but providing for the family’s welfare more broadly by ensuring health insurance – a responsibility that is internalized and often exchanged for the personal enjoyment of participating directly in fisheries.

“Well I call my husband a highliner because I have a federal job. As much as I want to be a fishing family where we all fish, I really don’t think I could abandon my steady paycheck with insurance job in order to do that. There is just too much risk for me personally.”

(Sitka female participant)

In cases wherein pluriactivity is coupled with the exit of the fishing partner from fishing, whether temporary or permanent, focus group participants noted that renegotiation of relationships and identities can also be difficult. In effect the adjustment is the opposite of what it is with increased effort because now the family has to adapt to the increased presence of that person within the household (Mederer, 1999; Mederer and Barker, 2000). Similarly to prolonged absences caused by increased effort, the upheaval is in the normal patterns and duration of entry and exit to which families are adapted and which are often internalized and manifested in their sense of identity. It is the fluctuation beyond the conventional norms that can be destabilizing to fishing families that have created lifestyles, identities, and dynamics based on intermittent presence (Binkley, 1996; Mederer, 1999; Mederer and Barker, 2000). At times, the concurrence of substantial income reductions from fishing

| Factor                      | Dimensions                                      |
|-----------------------------|-------------------------------------------------|
| Demographics                | age, gender, marital status, education, children|
| Capital investment in fisheries | size of boat, loans, type of boat              |
| Sociocultural factors       | macroeconomic trends, cultural norms           |
| Well-being dimensions       | years of experience and heritage, subjective well-being, prioritization of well-being components |
| Community factors           | transportation and technology access, fishing identity |
| Access to capital           | family financing, loan availability            |
and changes in established entry and exit patterns for the fishing partner within the household can be the most difficult dynamic faced by fishing families in transition (Mederer and Barker, 2000).

Even for families that may be able to remain within fisheries through various adaptations, numerous participants noted a shift in their perceptions of that participation and implicitly the value they derive from it. In effect there is an implied tradeoff in the adaptation strategies that they have employed to be able to remain within fisheries and their overall well-being.

“People used to be fishermen and now they have to also be business men. They have to understand the regulatory cycle, they have to understand what potential regulations are out there that might impact them.”

(Anchorage participant)

“When I first started fishing was not too long after limited entry in the troll fishery and ... the trollers often took time off and had cook outs and picnics on the beach. And then as the price of entry has gone up and salmon prices have gone down, relative to what people were making, there’s a lot less of that. People feel a lot more stressed to fish every day. Whether it’s a family fishery or not. So you see the families operating in a different way and when people are feeling that they really have to make the most of every day, now I am seeing less kids on the boats sometimes”

(Juneau participant)

The necessity of employing various adaptations that in many ways alter their fisheries participation has changed the nature of fishing work for many families, as noted by focus group participants. This has produced new subjectivities for those that have remained in fisheries by inter alia decoupling fisheries participation from kinship networks, shifting skipper-crew dynamics, and redefining family paradigms around fishing, breadwinning, and the household more broadly (Davis, 1986; Durrenberger, 1997; Mederer, 1999; Power, 2005; Power et al., 2014). Ultimately, although some have been able to mitigate livelihood declines with adaptation strategies, the cost has been borne on their way of life.

“it’s a lifestyle that has turned into corporate business and the lifestyle is what we are struggling with now”

(Kodiak participant)

As conditions in fisheries continue to change and at an accelerating pace, managers should consider how the policies that they employ may facilitate or impede adaptation and the well-being tradeoffs associated with various adaptation strategies. For instance, whereas LAPPs may have benefits in terms of addressing overcapacity and overfishing in fisheries with excess capacity, they may also impede entry and fisheries diversification opportunities, which have been a historically important mechanism for fisheries participants to respond to flux. When fishermen are not able to mitigate revenue losses, exit from fishing altogether becomes an adaptation strategy, but one that can also imply geographic migration and the loss of a way of life for generations (Ringer et al., 2018). Similarly, pluriactivity may be effective at attenuating household income declines but when that becomes the primary strategy of fishing families it may in fact signal unsustainability especially in the face of wider economic instability. For example, the COVID-19 pandemic has resulted in fishing revenue declines as well as an economic downturn that has disproportionately affected the service sector and, therefore, women’s employment in Alaska (Collins, 2020). Given the reliance of many fishing families on women’s labor to buffer household incomes, the pandemic may have revealed the weaknesses of this adaptation strategy. Other participants are employing value added strategies like direct marketing to address dockside price declines resulting from the pandemic – a laborious task that is also frequently undertaken by women in fishing families and implies a tradeoff in other potential uses of their time. In effect, managers may need to ensure that the tools that fisheries participants have at their disposal to adapt to change are as diversified as the conditions that they face, not funneling them towards singular strategies that may have limited adaptive capacity in response to varied conditions or unilateral disproportionate well-being effects.

4. Conclusions

Variability and adaptability are built into how fishing families define their underlying characteristics. Those uncertainties seem integral to how fishing families operate, and they have established strategies for dealing with them. However, with the unprecedented pace of environmental change over the last three decades and technological disasters, Gulf of Alaska fishing communities are responding to perceived shocks to a system beyond the established ranges of uncertainty, resulting in a variety of strategies from normative behavior to long-term renegotiations of relationships and identities. This is in part because strategies that were effective at adapting to changes within conventional bounds of risk may be insufficient in the face of challenges that are inherently unpredictable, especially as the pace of change increases. In addition, strategies have implicit tradeoffs between various well-being components so that an adaptation may be effective at mitigating adverse livelihood effects but at the cost of, for example, increased safety risks and less time spent with family. Coupled together these factors are resulting in fishing families throughout the Gulf of Alaska struggling to find new ways to maintain not just their livelihood but their overall well-being.

While this study demonstrates the variation in adaptation strategies and their evolution in response to the multiple facets of changing conditions, it also points to the necessity of understanding the underlying factors that inform adaptation choices. Changes in adaptations over time may be the result of not just necessity borne out of new and more dynamic conditions but the underlying characteristics of fishing individuals, families, communities, and the dynamics themselves. This may be manifest in a shift away from diversification of fishing portfolios, which is increasingly constrained by LAPPs, towards direct marketing strategies that may foster agency by decoupling earnings (to some degree) from global seafood trends, prices, and stock conditions. While the former may be more available to those with access to capital to invest in additional permits, the latter often necessitates comfort with technology and can be facilitated by a shoreside partner, all of which have varied demographic dimensions. Thus some of the distribution in response diversity may be explained by heterogeneity in the fishing population, in addition to the actual conditions. Especially in the context of Alaska, where communities are geographically isolated and many fishing participants are bounded in their adaptation choices by that isolation, adaptation strategies have to be examined at a localized level. Future extensions of this research necessitate systematic examinations of adaptations and their tradeoffs across multiple temporal and spatial scales, as well as actors and social institutions.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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