The Flow of Fish

The Kohala Center

Final Report

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Introduction

As early as the 20th C., the nearshore reef fisheries of the Hawaiian Islands were noted as containing fewer fish than in the past. Since that time, combined local pressures (coastal development, invasive species, overfishing) and global threats (climate change) have continued to accelerate declines. Of all these, however, overfishing is most often cited as the prime cause of resource depletion (Jokiel et al., 2011).

Yet the source of overfishing remains obscured in Hawaiʻi as detailed records are only taken of commercial catch. Yet non-commercial catch likely contributes significantly to recent declines in fish populations—the best available research estimates that catch from non-commercial fishers is three times that of the commercial sector across the state (Jokiel et al., 2011). Despite their apparent dominance in terms of take, these fishers do not have to report their catch. Several routine surveys by government agencies (Hawaii Marine Recreational Fish Surveys, 2011) and other organizations (see Hamnet et al, 2004, for example) have attempted to elucidate this "black box" of the fishery, but much still remains unknown.

Fishers around the world are known for their reluctance to divulge information about their practice. And, rightly so. Many a fisher has personally experienced the devastating depletion that happens when a favorite fishing spot is shared too widely with others. However, the fishers are the ones with the most knowledge of their craft and the environment that supports it. Their stories reveal the obstacles that currently prevent more sustainable practices; their insights help guide innovation towards opportunity for change. Therefore, it is to fishers and other members of the seafood supply chain that we must turn to listen and learn.

This project's ultimate goal is to design innovative solutions for increasing food security on Hawaiʻi Island by supporting more sustainable reef fisheries. Because of the lack of data on (especially) reef fisheries, it was determined that an island-wide assessment of the distribution of catch around the island—who caught what and where did that catch wind up?—would be a necessary first step in this process. After all, how can solutions be invented without a detailed map of the problems?

Our premise was that a more thorough understanding of how fish flowed across the landscape would help provide insight into the obstacles and barriers fishers and consumers face, and that these barriers, in turn, would help point the way to areas of opportunity ripe for development.

METHODS

The Approach

One of the main goals of the Flow of Fish study is to help determine best practices for approaching communities and gathering the kind of sensitive information required for understanding and improving marine resource use in Hawaiʻi. We therefore included social scientists on our own team and consulted with other experts in Hawaiian culture and anthropological studies to develop and refine our interview protocol throughout the study.

In order to facilitate a more open discussion, we decided not to develop a formal questionnaire and instead, stuck with a "talking-story" approach. The disadvantage to this approach is that at times, certain quantitative information was not captured. The advantages, however, were many:

- **Interviewees were provided the space and time to share their thoughts more comprehensively**. This allowed for more detailed information to surface than might have been captured by a formal survey. For example, by telling stories, fishers provided colorful narratives of their fishing history, and that of their parents, which often included discussion of their values and motivations for fishing without the interviewer having to directly ask such questions.

- **The format permitted tangential lines of thought to emerge that led back to basic information**. For example, in one interview, the fisher had briefly described how he learned to fish from a friend who now lives on Oʻahu. He then provided some of the basic information needed for the study, including where his fish was distributed (all within his home district). Later, however, when discussing the methods of his fishing, he described at length the close bond he developed with his friend, who taught him to fish. In return for all the teaching, the fisher said he often sends some of his catch to his friend on Oʻahu. The interviewer was then able to confirm that some of the fisher's catch leaves the island.

- **Story-telling surfaced insights and issues that we had not yet considered important**. As interviewees offered insight outside of the more focused lines of questioning, we had the opportunity to explore these issues in future interviews. While a good formal survey will always incorporate a "ground-truthing" process to make sure that the questions asked are capturing accurately the data the interviewer is seeking, it is much harder to capture information that the interviewer may not have thought to consider.

An example of this was when one fisher described a connection between drug-use and fishing. This sparked the idea to ask fishers more directly if they had thoughts about the larger-scale societal drivers behind any changes or practices that they observed.

Another important development in our process was to provide an opportunity for interviewees to review our notes from the initial meeting. We thank Kepa Maly for guiding us in this new direction. This development serves three functions:

Improves accuracy: it provides an opportunity for interviewees to edit/check interview and make sure information is correct and includes all relevant details.

Builds trust: it allows interviewees to feel more comfortable, knowing that the information they share at the interview is something they can review. And it gives the interviewer the chance to show transparency and good faith in capturing and accurately representing the stories/information shared.

Increases referrals: by providing an opportunity to check back with the interviewees, the follow-up offers the chance for the interviewer to ask for referrals. Often, interviewees think of persons to recommend (or perhaps are more willing to share their knowledge about people) after they have had the chance to look over the interview notes, and are familiar with the process.

The drawback to this development is an additional lag time. After writing up interview notes, researchers must either send by e-mail or provide a hard copy for interviewees to review. Then, researchers must follow up to solicit feedback. We found that it can take several weeks for interviewees to review and provide this feedback. Phone calls to follow up are critical (e-mail correspondence is inevitably slow). However, we believe that the pros of this development far outweigh the cons of extra time, given the overarching goal of increasing trust and building positive relationships.

The Process

We began our interviews by reaching out to personal contacts within The Kohala Center network and the network of team members of our research group. We found that individuals were most engaged (and willing to participate) when we presented the study in the context of food self-reliance and food security. Making clear The Kohala Center's overarching mission to create educational and job opportunities on Hawai‘i Island that are culturally and environmentally sensitive and explicitly stating that we were not connected with any regulatory agency also helped overcome suspicion.

We also found it useful to explain that our goal was to hear, straight from the source (i.e., fishers and other sectors of the seafood supply chain), the obstacles that they faced and to solicit their ideas for how to overcome those obstacles. Interviewees also seemed more comfortable once we explained that all data would be averaged at the district level, so that

detailed information, especially with regard to their fishing locations, would not be necessary. Finally, asking people to share their fishing history also seemed to set people at ease and was a more comfortable (and logical) place to start.

In order to expand our sphere of contacts, we spoke with experts in the field of marine conservation, government officials, and industry leaders who helped provide us with insight into how to develop our interview process and also provided leads on contacts to interview. In addition, collaborations were key to developing contacts outside our immediate network. We engaged with NOAA researchers on a mapping workshop that brought together diverse marine resource users in North Kona and South Kohala. In addition, funding also helped support undergraduate researchers in UH Hilo's Marine Anthropology course. These students conducted dozens of interviews with individuals from different sectors of society that we would not have had opportunity to reach.

Finally, we attended public meetings organized by federal and state bodies on issues relating to marine resource use in Hawai‘i in order to meet and introduce the project to individuals involved with fisheries.

It is important to note that initially, the project was designed to interview individuals from all different sectors of the seafood supply chain—from producers (fishers of all kinds) to wholesalers, distributors, retailers and end-users (chefs, restaurant owners). However, due to time constraints and the more pressing need for information on reef fisheries (because of a lack of data and the current state of decline in this sector), we shifted focus approximately halfway through the study to non-commercial reef fishers.

GIS Database Development and Quantitative Analyses

Working closely with the University of Hawai'i at Hilo's GIS lab, we designed a GIS database to organize and house information from all interviews. For GIS work, we focused on the recreational fisher sector and organized all quantitative information to promote standardization and effective visualization of the results.

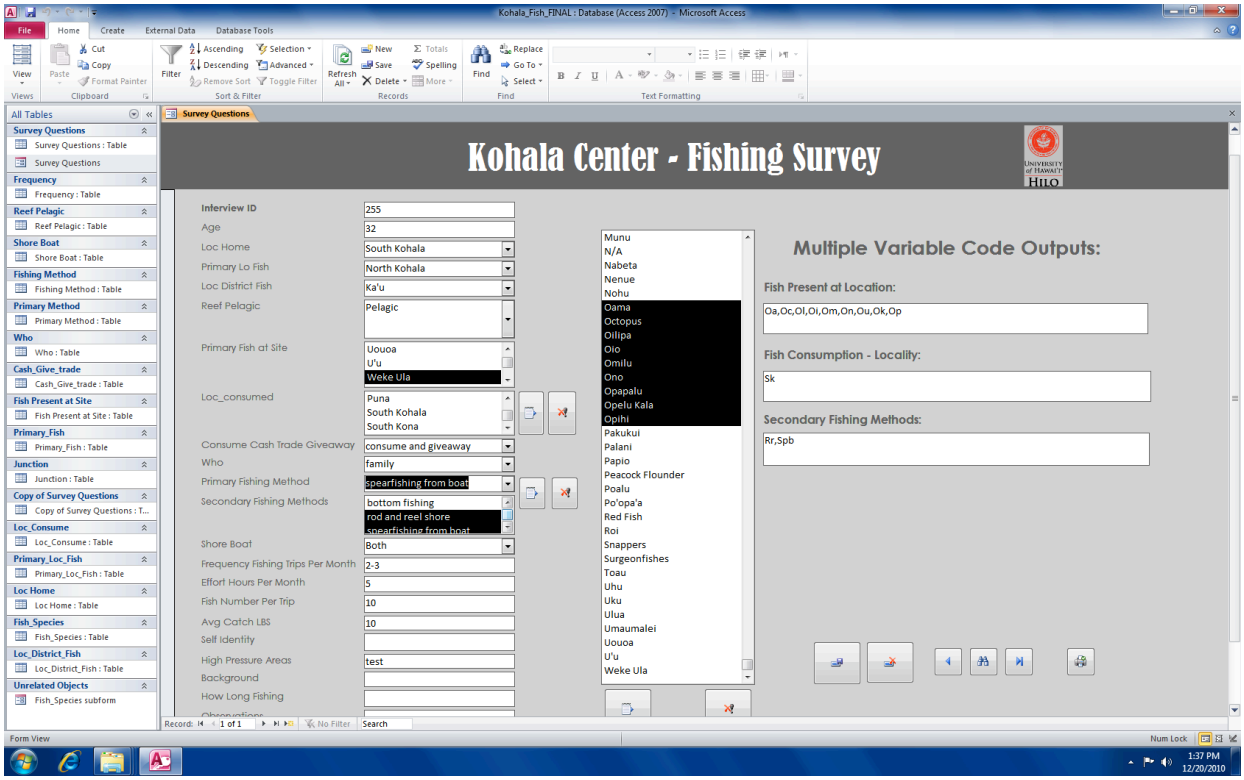

Figure 1. GIS Database. Showing the main categories used to organize the data, and the various sub-categories that emerged from fishers' responses.

The data entry form, created with Microsoft Access, is shown in Figure 1, detailing the main categories and associated variables used to identify and categorize interviewees and their responses. To create this database, all interviews were reviewed and quantitative information was pulled and categorized according to basic variables used to identify the interviewee (such as Age, Home District, etc.) and specific data targeted by the interviewer (such as species caught, frequency of fishing trips, method of fishing, distribution of catch). The database was continually refined as more interviews were added to make sure that the information was preserved at the most detailed level possible while assuring consistency and accuracy.

For example, the category "Loc home" contains district information at the more refined scale of north and south, such as "North Kohala" or "South Kona." However, because all fishers did not

include this level of detail in their responses, we also created the Judicial ID category, that identifies the 6 districts of the island: Hilo, Puna, Kaʻu, Kona, Kohala, and Hāmākua.

The database includes 25 main categories described in detail in Table 1.

Table 1. Main categories and definitions for use in GIS database.

Category	Definition
Interview ID	Identifying number of interview. This was given in chronological order of when the interview was entered into the database and corresponds with first number in saved MS Word documents
Age	Age of fisher in years
Loc_Home	District where fisher lived, includes North and South subdivisions
Judicial_ID	Number that corresponds with State GIS District layers for home location of fisher
Primary_Loc	Primary district fished by fisher
Loc_fish	All districts fished by fisher
Reef_Pelagic	Type of fish caught by fisher (Reef, Pelagic, or both)
Primary_Fish	Name of the primary fish caught by fisher (Hawaiian or Common)
Species	Names of all fish (given in common or Hawaiian names) caught by fisher
Loc_Consumed	Location(s) where caught fish is consumed
Consume	Describes what is done with catch (consume, giveaway, trade, sell)
Who	Who catch is distributed to (family, friends, neighbors, other, or not applicable)
Primary_Method	Primary method of fishing practiced by fisher
Fishing_Method	All methods of fishing practiced by fisher
Shore_Boat	Whether fishing is done by boat, from shoreline, or both
Avg_Catch_LBS	Average catch in pounds (lbs) per month
Fish_Number_Per_Month	Average number of fish caught per month
Effort	Average number of hours spent fishing per month
Frequency	Average number of fishing trips per month
High_Pressure	Areas noted to be under high pressure from fishers and other ocean resource users
Self_Identify	How fishers describe themselves with regards to fishing
Background	Ethnic background of fisher if provided
How_Long_Fishing	How many years fisher has been fishing
Observations	Brief summaries of qualitative observations provided by fishers
Species_Present	Same as “Species” above- added to facilitate ease of access to species list (internal GIS set-up issue)

The database allowed for the creation of maps, which visualize quantitative spatial data. However, because information was collected in a qualitative fashion, adjustments had to be made to standardize the data before maps could be created.

When asking fishers how often they fish, how many hours they spend fishing, the number of fish they catch, and how many pounds of fish they catch, some fishers responded by saying they go fishing all the time; fish all day long; catch stringers full of fish; or coolers full of fish. When these type of responses were given without further or specific detail to numbers, the data point was not entered and left blank. However, this information was taken into

consideration when analyzing the trends revealed in the data (i.e., we noted how many fishers from a particular district had mentioned they fished “all day” when looking at effort data).

When given a range of numbers as a response to the same questions, an average was taken. For example, if a fisher said he/she went fishing 3–4 times per week, the average of those two numbers was calculated to be 3.5 times per week. The same method was used to reach average numbers when given ranges for effort (hours spent fishing), number of fish caught per trip, and pounds of fish caught per trip.

Then, in order to standardize across fishers, we determined that a monthly time scale was the most logical unit to apply, as many fishers gave us responses in “per month.” For those that did not, we multiplied by the appropriate conversion. For example, if the average number of fishing trips per week was 3.5, we multiplied by 4 (number of weeks in the month), to get a total of 14 fishing trips per month. This number was then entered for their frequency of fishing trips per month. The average number of fishing trips per month was then used to calculate the average number of hours fished per month, the average number of fish caught per month, and the average number of pounds of fish caught per month. So if a fisher fished an average of 14 days per month and caught 10 fish on each trip, the data entry for our database would be a total of 140 fish caught per month.

Other times fishers described their frequency of fishing trips in ways that were more sporadic. For example, some fishers mentioned fishing everyday sometimes when the fishing is good but later said that their usual amount of trips made were 1–2 times per month. In these cases, we used an average taken from their usual fishing habits (for this example, 1.5 times per month). Another fisher reported that he had fished about 10 times in the past 2 years. In order to get a standardized monthly average to fit in the database, the number of fishing trips, 10, was divided by the time frame given in months (24) to get 0.42 trips per month.

In all cases, as quantitative data was analyzed, we continually referred back to the original interview to make sure we stayed true to the context and accounted for these subtle but important variances as much as possible.

Qualitative Data Analysis

The interviews provided valuable qualitative information in addition to the quantitative data. In order to synthesize the ideas, insights, and perspectives of over 70 interviewees, we developed a system to organize the interviews, identify themes, and then work to document patterns within those themes.

First, two lead researchers re-read every interview, highlighting ideas related to the main themes of “problems/obstacles/sources of frustration,” “things liked or disliked,” and “solutions/ideas for improvement.” After this initial pass through, the researchers discussed

their findings, and came to an agreement on the most prevalent and robust themes that emerged from the interviews. Once consensus was reached at this level, researchers then went back to the interviews and identified more specifically how many individuals mentioned a specific theme, and in what capacity (i.e., we began to identify sub-themes within the major categories).

Based on these categorizations, we began to identify patterns, and discern insights into areas that might provide opportunities for future initiatives to take place and help move forward more sustainable reef fisheries in Hawai‘i.

Results

Overall Interview Effort: Who Did We Speak With?

We conducted a total of 116 interviews from all sectors of the seafood supply chain including 74 fishers, 4 charter boat captains, 10 restaurant owners/chefs, 8 retailers, 2 wholesale/distributors, 4 elder fishers (no longer actively fishing but provided perspective), and 14 experts (academics, government officials, industry experts). The duration of interviews ranged from 15 minutes to three hours (average of 54 minutes) and occurred over the phone or in person.

We interviewed individuals 18 to over 75 years old. The majority of our interviewees were men, but we did have five women fishers and several women restaurant owners/chefs.

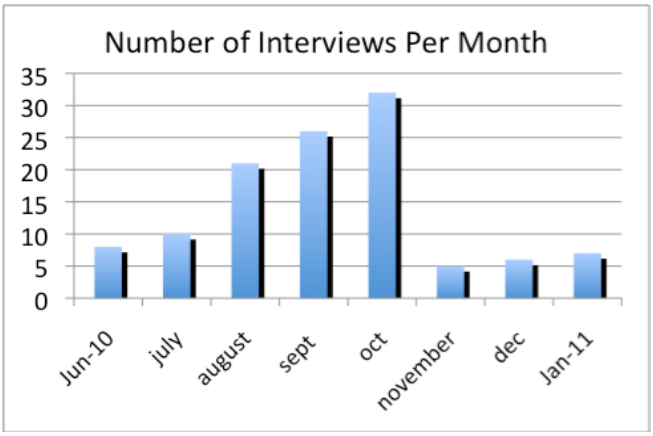

Figure 2. Number of interviews conducted each month

The rate of interviews increased over time as we built out our network and began to receive more referrals from those to whom we initially reached out. The number of interviews conducted each month during the study period is shown in Figure 2. This figure includes an estimate of half the interviews by the undergraduates in September and half in October, helping to contribute to the rise in interview rate during this time. November and December proved difficult time-wise because of holidays and many referrals that we received were postponed during this time. By January we were turning our focus to synthesizing the data collected and therefore were not able to pursue further interviews at that time (although we have many contacts remaining).

The general increasing rate of interviews shows support that our method for connecting with fishers was successful but also highlights that there is an inherent "building" stage with this kind of work. Several of the experts we spoke with cautioned us that this lag time was common, and therefore needs to be incorporated into any future timeline for projects where community engagement is required. We found that two months was the approximate period of time needed to start generating more contacts at a consistent rate.

In addition, the degree to which we received referrals also reflects positively on the approach. Table 2 shows a breakdown of the generation of referrals for the study. As can be seen in the

table, the number of referrals that were being generated by second and third-level contacts were consistent, showing a transfer of trust from word-of-mouth networking that provided an ever-growing list of contacts for the study.

Table 2. Number and type of referrals passed during the study.

Referral Level	Definition	Number of Referrals
1	Personal contacts of The Kohala Center or research team, including undergraduate researchers	70
2	Individuals referred by our network of personal contacts	72
3	Individuals referred by 2nd level contacts	19
4	Individuals referred by 3rd level contacts	18

Success Ratio

In order to gauge how our approach worked, we created a "success ratio," defined as the ratio of successful interviews completed (number of "yes") to attempted contacts (number of "yes" + "tried"). Our success ratio for all sectors was 80%, and this was also the success ratio for fisher-only data.

Given the focus of this study is on reef fishers, this report presents the qualitative and quantitative analysis of the 74 fishers interviewed. A brief summary of findings from interviews with individuals further up the supply chain is provided at the end of the results section.

Quantitative Analysis

Where Are These Fishers From?

Of the 116 total interviews we conducted, 74 were with individuals who were reef fishers, reef and pelagic fishers, or pelagic fishers that fished mostly for food and thus were lumped in with this category (as opposed to charter boats). The total number of fishers that we interviewed in each district is given in Figure 3.

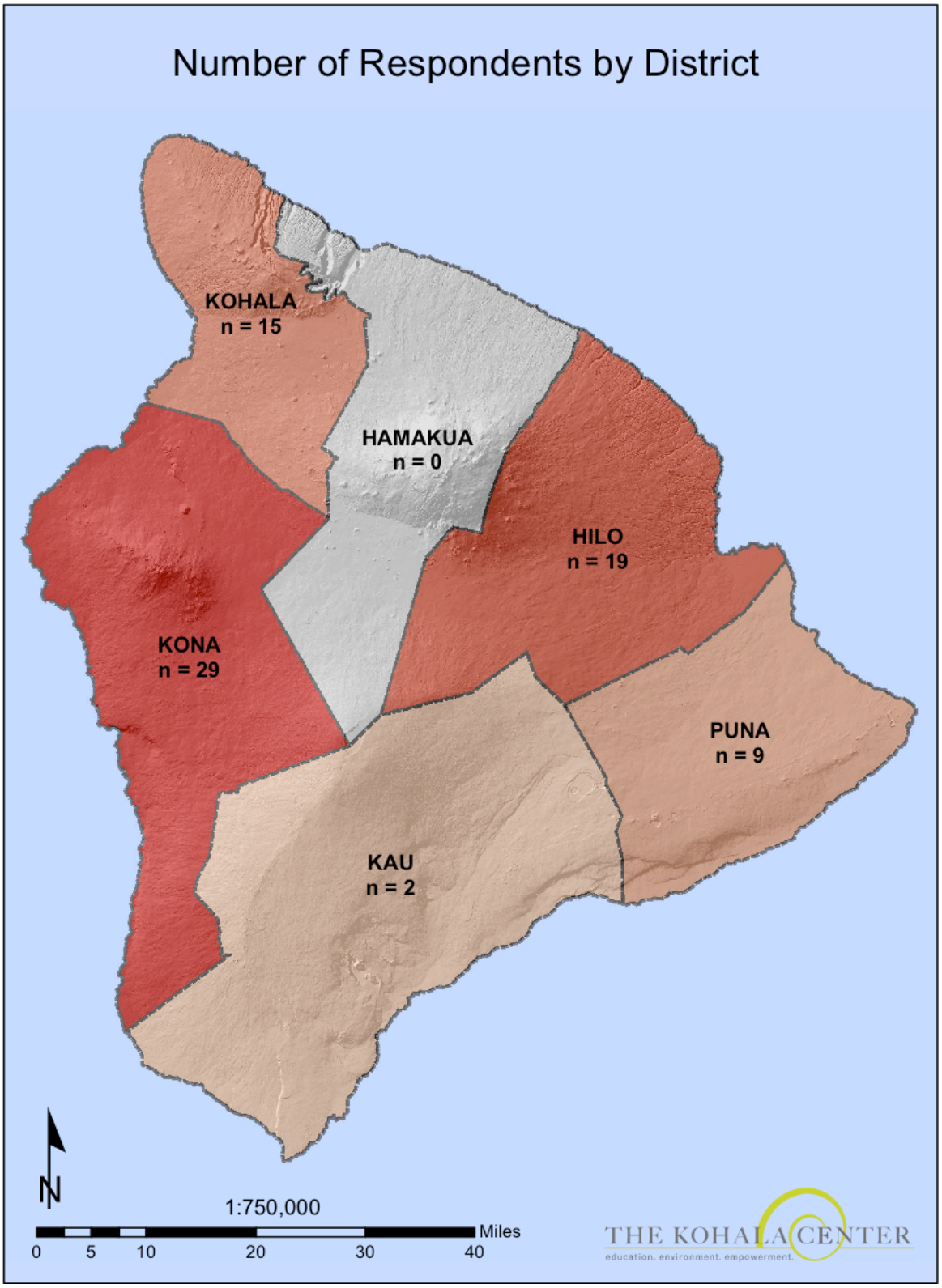

Figure 3. Number of fishers interviewed from each district.

Unfortunately, we were not able to connect with any individuals who lived in the Hāmākua district (fishers in Waimea were grouped into the Kohala district). Also, we were only able to interview 3 fishers from Kaʻu (the last fisher occurred too late to include in maps). We were able to generate more contacts within each of these two under-represented districts, but due to logistical constraints we were not able to follow through with interviews at this time. Because of the low sample size in Kaʻu, analysis and discussion of results will focus on Hilo, Puna, Kohala, and Kona districts.

We had an almost equal representation of fishers from east and west Hawaiʻi, with 28 total from the east side (19 from Hilo and 9 from Puna) and 29 in Kona. We also were able to conduct 15 interviews with individuals who lived in Kohala, including Waimea.

What Kinds of Fishers Are They?

On an island-wide basis, we found that 64% of the fishers we interviewed fished only reef fish, while 27% fished reef fish and pelagics, and 9% fished only pelagics.

These proportions were more or less preserved on the district-level (Figure 4). Hilo, however, lacked any pelagic-only fishers. A significant proportion of fishers targeted both pelagic and reef fish in each district. A quarter of fishers in Hilo and Kona fished both, while nearly half did in Puna. Kohala fishers were equally divided between only pelagics and both pelagics and reef fish at 13% each.

We also added a layer of data to explore whether or not these fishers were selling their catch. This level of inquiry is particularly important as this is the information that is generally used to set up management systems. Hawaiʻi is especially difficult for categorizing fishers because they do not neatly occupy the typical binary categories of “commercial” or “recreational” as can be seen from Figure 5 (Glazier, 2007).

The majority of fishers we spoke with who targeted only reef species were non-commercial fishers, with none claiming to be commercial, and only a small portion (10% in Hilo and 7% in Kohala) selling any of their catch. Likewise, none of the relatively large portion of fishers that described their catch as both reef fish and pelagic (yellow pie wedge in Figure 4) claimed to be commercial. Between 7–13% of these individuals sold some of their catch in Kohala, Hilo, and Kona. None of the fishers we spoke with in Puna claimed to sell any of their catch at all. The only category for which we had some fishers claim to be commercial were pelagic fishers in Kona.

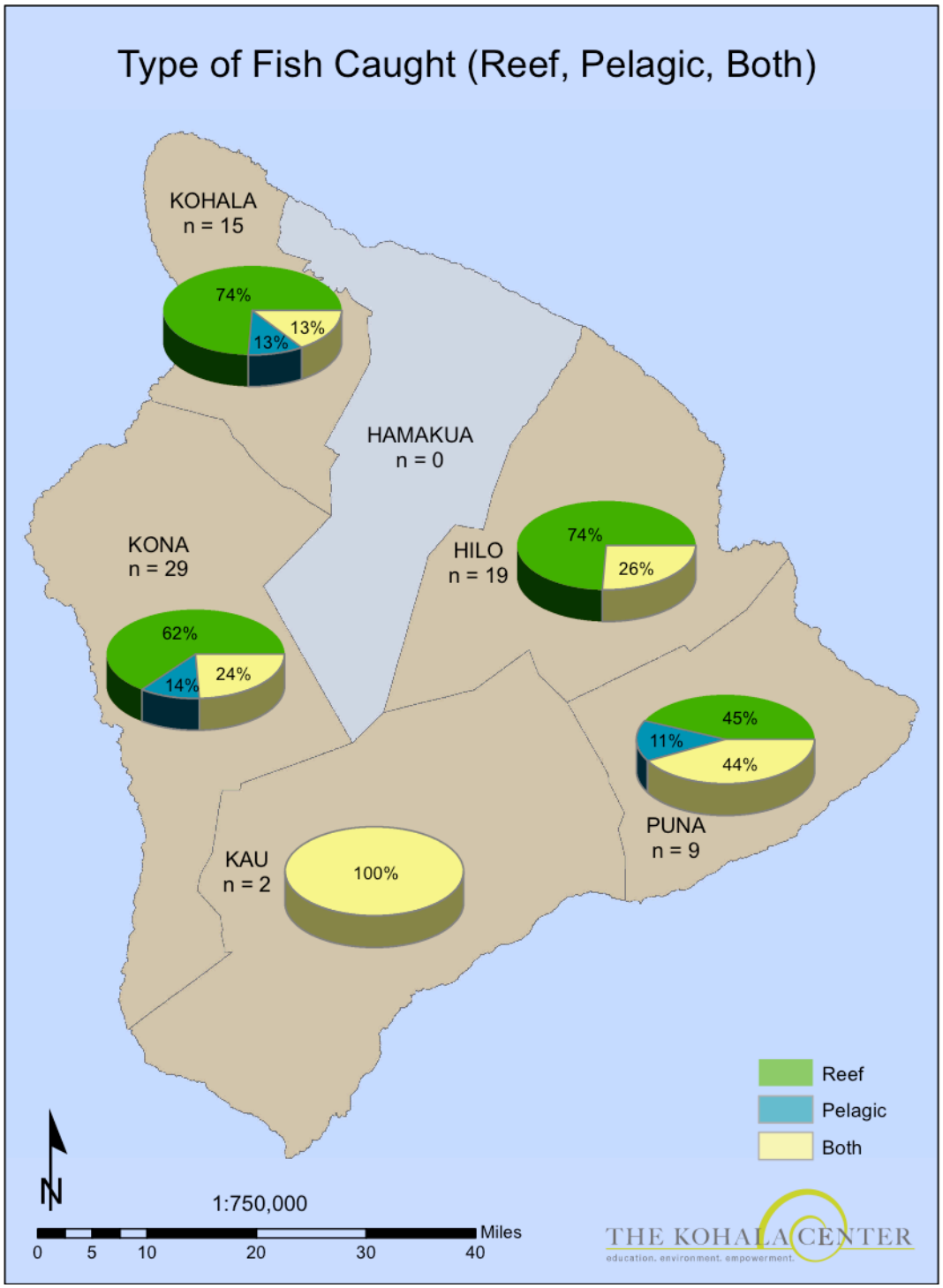

Figure 4. Type of Fisher: Reef, Pelagic, or Both by district.

The vast majority of the fishers claimed to be reef, non-commercial fishers. However, the combined percentage of fishers who sold some of their catch (be it reef, pelagic, or both) was about 20% in Kohala and Hilo, and about 10 % in Kona. We view these as conservative estimates for two reasons: (1) fishers would often claim not to sell their catch, but further on in conversation mention how they offset costs through sale (see more on this in Qualitative Analysis: Theme III: Commercialization)—many simply don't consider this as "sales" and thus, some fishers we spoke with may offset their take but not have mentioned it, even when asked; (2) individuals who sell their catch but do not have a CML are less likely to admit to these sales.

Thus, use of "shoreline fisher" or "reef fisher" may be a more accurate description (or more likely predictor) of a fisher's activities than the use of terms such as "recreational" or "commercial." None of the 74 fishers we interviewed considered themselves commercial fishers, and many also shirked the label "recreational," as those who fished for food or tradition did not consider what they were doing "recreation." (Charter boat captains, however, all considered themselves recreational and strongly rebuked the title of "commercial").

Another potential layer of association is how fishers fish: from shore, by boat, or both. Results of this data are mapped in Figure 6. We found that the majority of fishers who use a boat also do some form of shoreline fishing. This may be an artifact of our survey approach, which was targeting reef fishers, but it also makes sense from a weather and financial perspective: fishers mentioned that when the weather was rough, they would shoreline instead of taking out a boat; also, if finances are tight, it is cheaper to go to the shore to fish than pay for the fuel for the boat. In addition, not everyone can afford a boat, and many of the individuals we spoke with fish on a friend's or a family member's boat. Thus, if their contact is not going out, they resort to shoreline fishing.

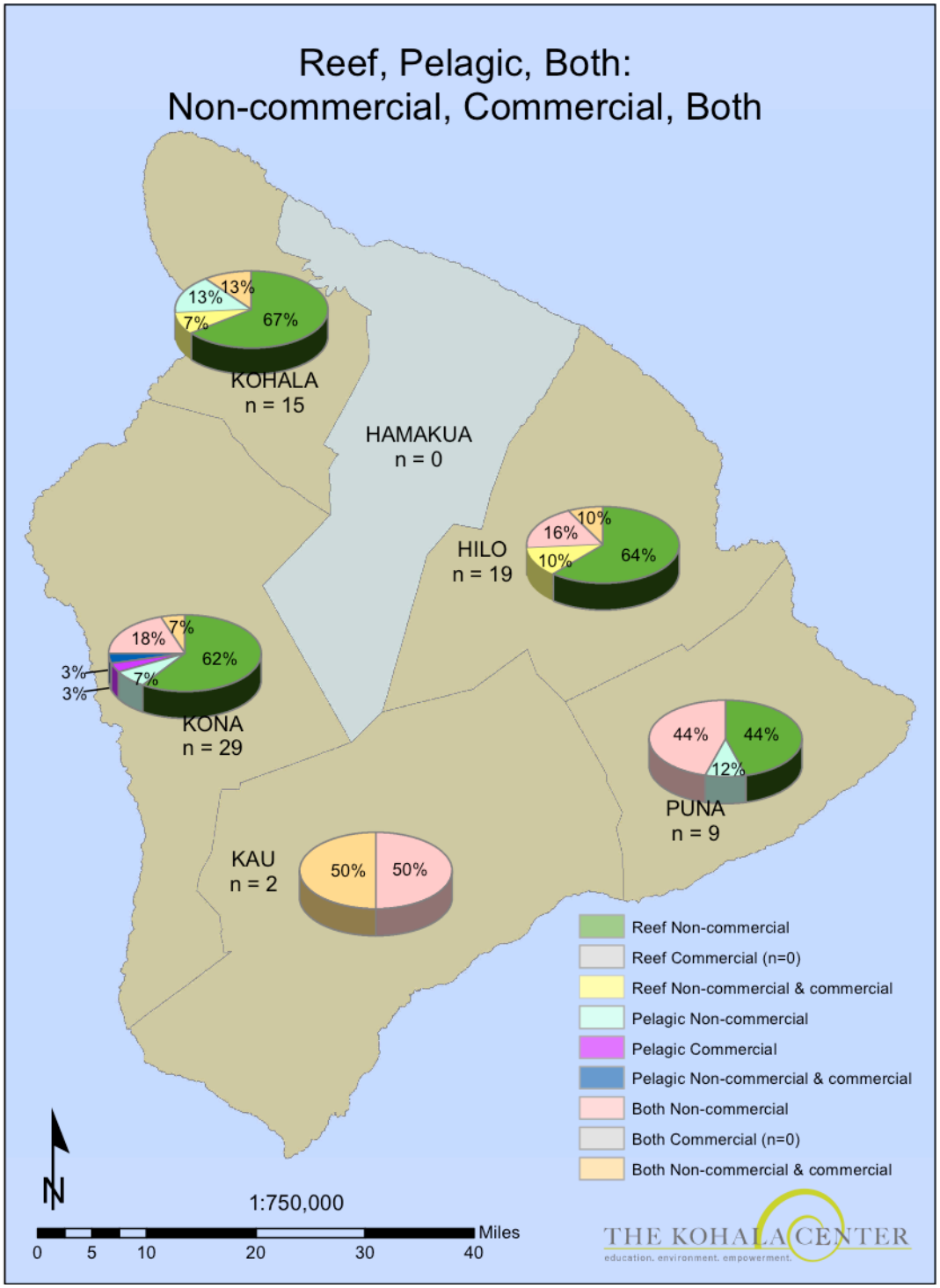

Figure 5. Type of fisher by target fish group and commercial/non-commercial status.

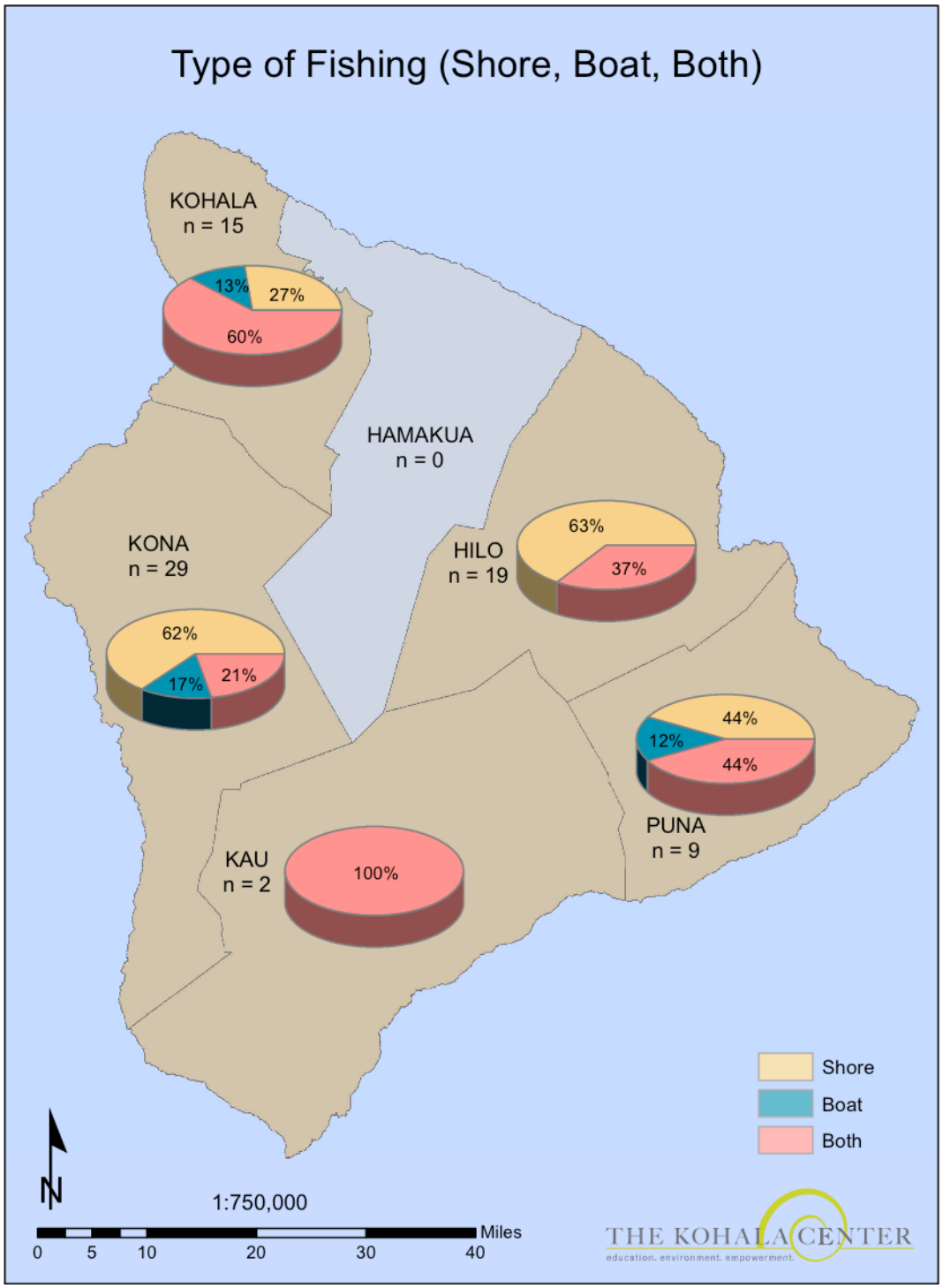

Figure 6. Type of Fishing: Shore, Boat or Both by district.

Not surprisingly, there appears to be an association between the type of catch (reef, pelagic, or both) and the type of fishing (shoreline, reef, or both). The percentage of fishers who fished only pelagics nearly match the percentage of fishers who only used a boat. The same association was found between the percentage of fishers targeting only reef species and fishing only from shore. Similarly, the percentage of fishers who target reef fish and pelagics ("both" in Figure 4) was similar to the percentage of fishers that used both boat and shoreline-based fishing. These correlations make sense—we would expect pelagic fishers to, in general, utilize boats more than reef fishers (though this is not always the case) and reef fishers to stick to the shore more. What these patterns suggest, however, is that categorizations by shore or boat may be another means for organizing fishers that reflects more truly the type of catch they are exploiting (rather than recreational or commercial categorizations).

The only district where this pattern does not hold was Kohala, where the percent of fishers who catch reef fish only is far greater than the percentage of fishers who only fish from shore. This indicates that in Kohala, at least, a larger portion of the reef fish may be caught by boat than from shore, compared with other districts. Of course, any examination of the frequency of boat use must consider the location of boat ramps: in Kohala, there is both Kawaihae harbor and Puakō boat ramp which facilitate easy access to the reefs (there is also a hoist at Māhukona, though we did not speak with anyone who mentioned it specifically as something they used; and another ramp at Kēōkea which takes some skill to launch from). The presence of these potential access points could explain this finding.

Whether a fisher uses a boat or the shoreline, however, does not appear to predict what is done with the catch. We found no strong patterns in comparing commercial vs. non-commercial use (or both) of the catch and shoreline, boat (or both)-based fishing activities (Figure 5). This is despite the strong perception by some fishers that boat fishers tend to be more commercially oriented, "shoreline fishers fish to feed people; boats fish to sell." Certainly boat-based fishers have larger expenses that could incentivize fishers to offset with sale of some of their catch, but there is some commercial sale from shoreline fishers as well. However, given the lack of interviews with any commercial reef fishers, and only a few with commercial pelagic fishers, no definitive conclusions regarding the association between shoreline use or boat use and commercial activity can be made at this time.

These findings summarized thus far support previous studies that identify the need for regulations to be more flexible and adopt a non-binary approach to categorizing fishers. Many fishers are neither commercial nor recreational, but straddle the two spheres—by selling their catch or trading it through formal and informal markets. What they target (i.e. reef versus pelagic) appears as a more useful means of managing fishing activities than asking them to define themselves as commercial or recreational.

How Do They Fish?

There is another way of looking at types of fishers and that includes looking at their fishing method (gear), how often they fish, and how long they fish. The fishers we interviewed were not only diverse in the types of methods used among them, but also individually: over 75% of all fishers used two or more types of gear. Rod and reel and spearfishing from shore were the most popular methods employed in all districts (Figure 7). In general, Puna had a more even distribution of methods, with about 10% of all fishers spearfishing from boat, trolling, throw net, and bottom fishing. Other districts were more dominated by rod and reel and spearfishing from shore, with a smaller percentage of fishers dabbling in other gear types.

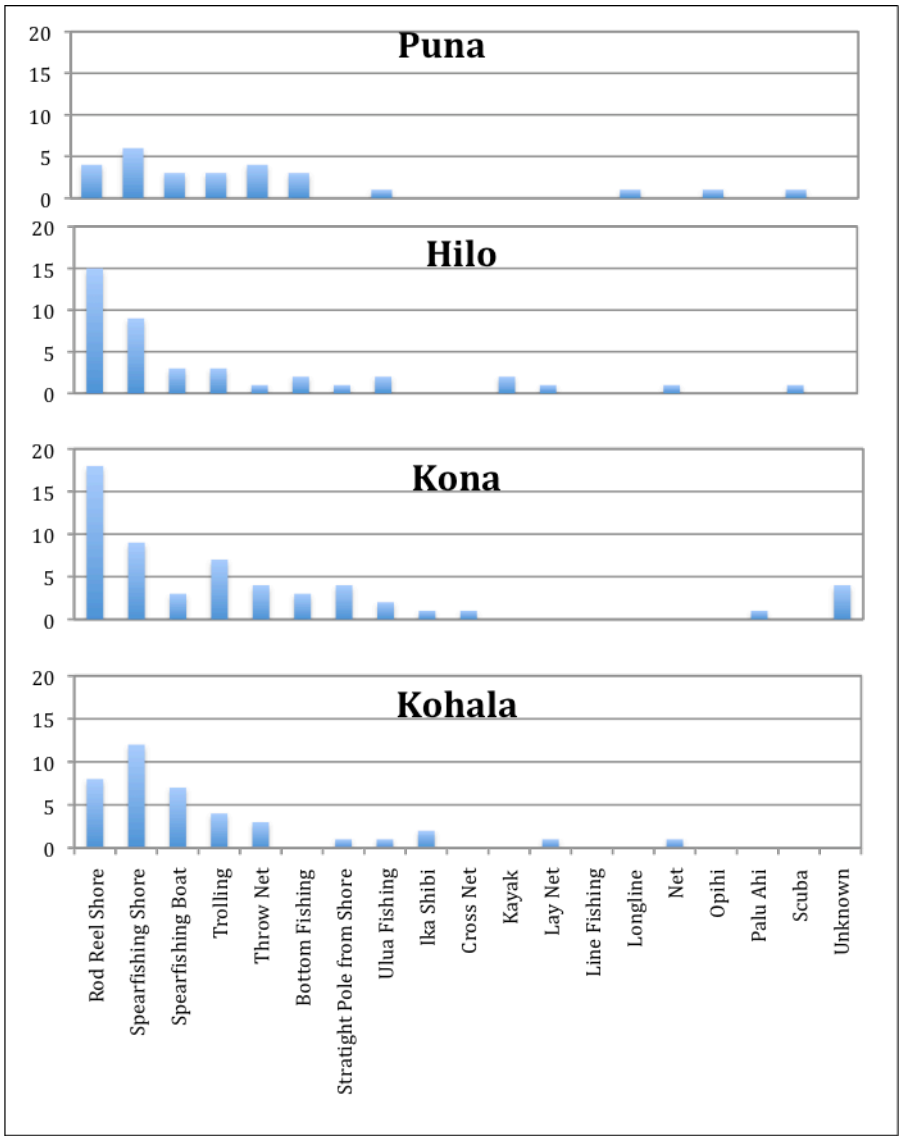

Figure 7. The number of fishers who use various types of fishing gear.

The exception to this was trolling in Kona and spearfishing by boat in Kohala, which also had more than 10% of fishers participating. Not surprisingly, Hilo fishers did not employ spearfishing from boats or trolling as much as the other districts, which matches the lack of boat-only fishers reported in Figure 6.

Our findings differ from those reported to the State in the CREEL surveys (Figure A1) in that rod and reel fishing among our fishers was not nearly as dominant as in the State's database. According to the State, over 80% of all fishers in all districts use rod and reel fishing, with other gear types used less than 10% of the time. Our data showed that more fishers from Puna and Kohala used spearfishing (boat and shore-based) than rod and reel, and in all districts, rod and reel was never more than 37% of all gear types used.

It is unclear why our data would show this strong contr ast, but it must be kept in mind that the number of interviews from each district we spoke to was significantly less that those contacted by the CREEL surveys. However, it is also possible that CREEL surveys tend to locate and find rod and reel fishers more often than other types because the survey design is based on a shoreline-intercept method, and fishers using rod and reel from shore are easier to locate and approach than spearfishers who must be caught entering or leaving the water, for example.

We also investigated the time commitment of fishers to their fishing activity, both in terms of how often they went fishing (number of fishing trips per month) and how long they spent fishing during each trip (effort). Both of these factors were extremely variable, with individuals offering a wide range of answers that varied by month, season, and year. In addition, different fishers inherently had higher or lower levels of commitment, depending on factors such as employment: "I would like to go more often, but fishing's a hobby, not a job so I still have to go to work during the week." Other fishers mentioned kids/family obligations ("used to go more before the kids," or "I can only go when my 'honey-do' list is done"), weather, and cost (this was for boat-users) as limiting both fishing trip frequency and duration of fishing trips.

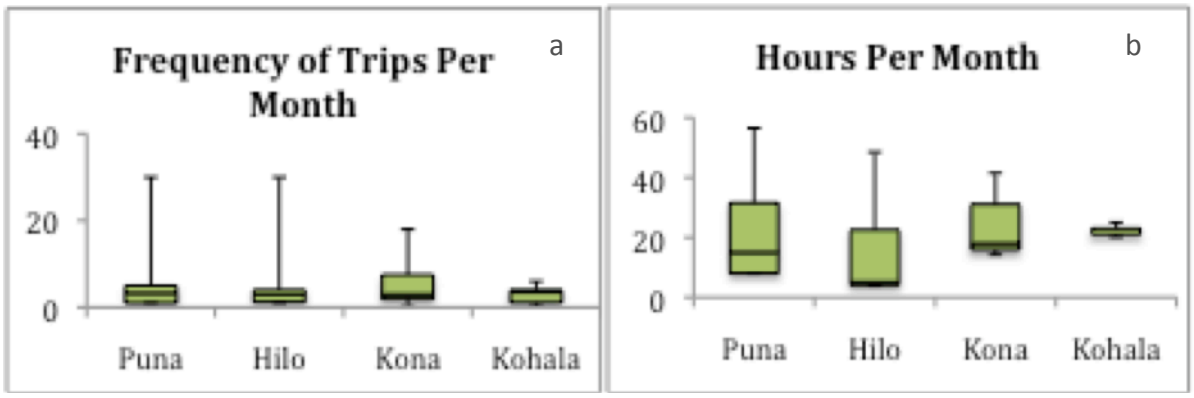

Figure 8. Effort data. (a) Trips per month; (b) Hours per month. Boxplots show 1st and 3rd quartiles, horizontal black line depicts median. Whiskers show min and max values.

Figure 8 illustrates the average number of trips per month (frequency) and by correlation, the hours per month (average hours per trip * frequency). There were several "outlier" fishers who fished everyday and others that would fish multiple hours in a day (such as all night). Unfortunately, the sample sizes were low for both of these categories, which makes actual comparison among districts difficult. What can be said is that in terms of frequency of trips per month, half of the fishers we spoke with fish more than 3 times per month, but most fish less than 7 times per month. As for effort, more than half the fishers in Kona, Puna, and Kohala fish 15 hours a month, but most fish less than 30 hours per month for all districts. In Kona and Puna, most fish less than about 30 hours per month. Half of Hilo fishers fish less than 5 hours a month, the shortest duration of all districts.

What Do They Fish?

Besides identifying fishers as targeting reef, pelagic, or both sets of species, we also attempted to gather information on a more species-specific level. As we have noted with almost every other characteristic, fishers also proved highly variable in their catch, with some mentioning taking only one or two species, while others listed up to 26. Approximately half of all fishers described somewhere between 2 and 10 species as their "typical" catch.

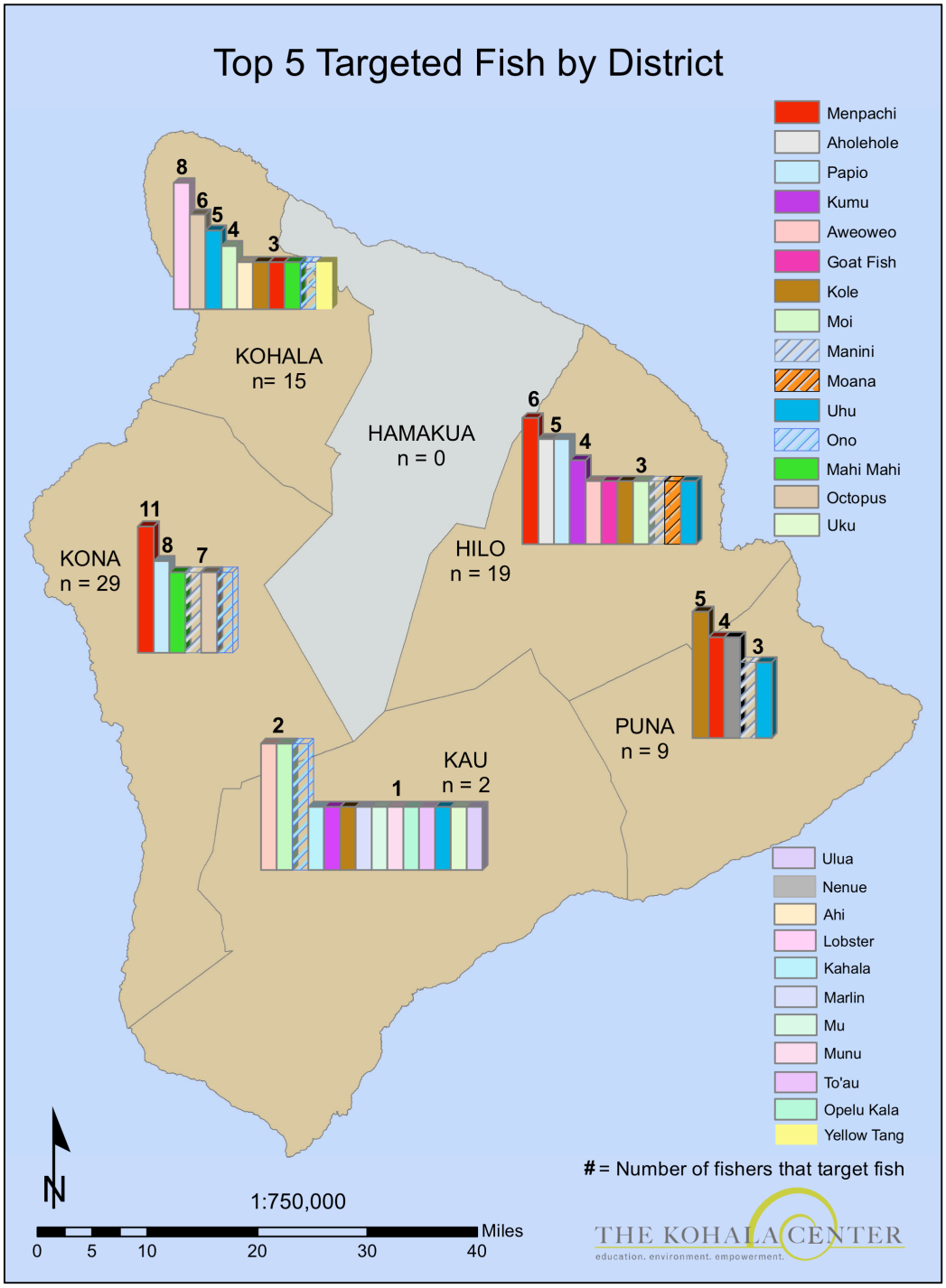

Figure 9. Top 5 most commonly mentioned species for each district. Numbers represent the number of fishers who mentioned each fish.

On a district level, there were both commonalities and differences in terms of the species caught. Of the top five most commonly mentioned species, Menpachi was included in all four districts (Hilo, Puna, Kohala and Kona) while *Uhu*, *Kole* and *Manini* were present in three of the four. However, after these species, districts varied in terms of the fish reported (Figure 9).

It is important to note, however, that this and catch abundance, were perhaps the most difficult to capture accurately. This is because fishers often would say "and other reef fish" or simply "I catch whatever bites, reef fish." In terms of abundance, fishers were even less detailed with their answers, often saying it depended on the day, or that "there is no such thing as an average day." Some would offer "catch a few" or "several" as an answer, but when asked to put that into a number or weight, would say they couldn't say.

Nineteen individuals did not provide any species-specific data, while only 9 provided an estimate of weight of catch. Approximately 30 interviewees provided an estimate of the number of fish they caught. For all districts combined, 75% of fishers caught less than 64 fish per month, with about half of all fishers taking fewer than 18 fish per month.

Flows of Fishers and Fish

One of the major components of this study was to determine where fishers fished and where their catch wound up. This is what we termed "the flow of fish" and it provides insight into how local seafood supports the diet of different communities across the island, how each district contributes to the supply of local seafood consumption, and the connections among different districts .

Not surprisingly, we found that most fishers fished within their home district and consumed the majority of their catch there as well (Figures 10-15).

Fishers from Puna fished in every district except for Kohala. Over half of the fishers interviewed in Puna mentioned fishing in either Hilo or Kaʻu, but only two fished in Kona and one on the Hāmākua coast. There was almost as much consumption of catch outside of Puna as within the district, with catch eaten in Kona, Hilo, and two fishers sending their catch to Oʻahu to family.

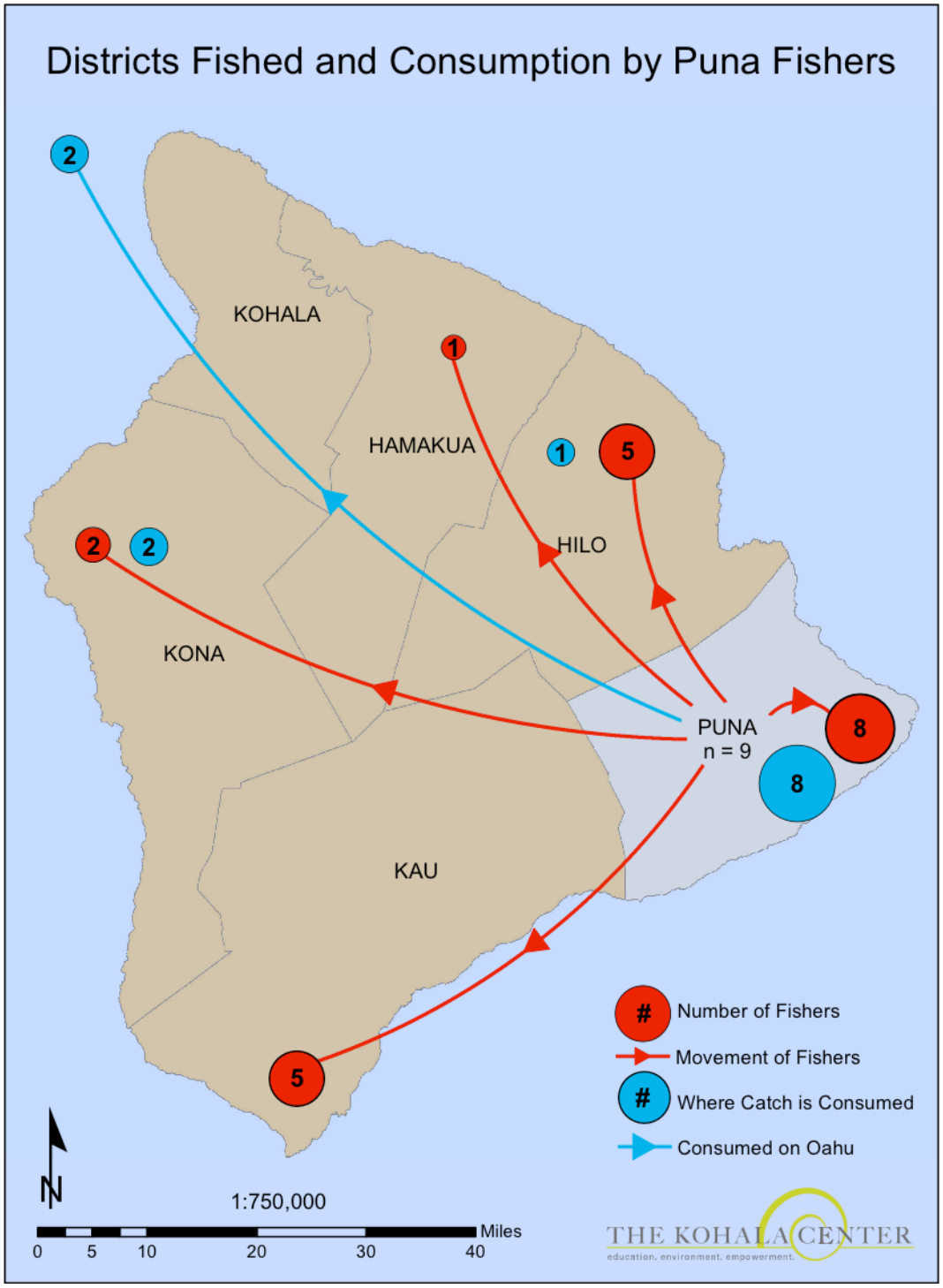

Figure 10. Flow of fish and fishers from Puna to other districts.

Hilo fishers had a similar pattern, with more than half of fishers noting Puna and Kaʻu as regular fishing grounds. Nearly half of all Hilo fishers also fished in Kona (a greater percentage than those from Puna). About 25% of Hilo fishers also fished the Kohala coast and slightly more than that fished the Hāmākua coast. However, a smaller proportion of fishers ate their catch outside

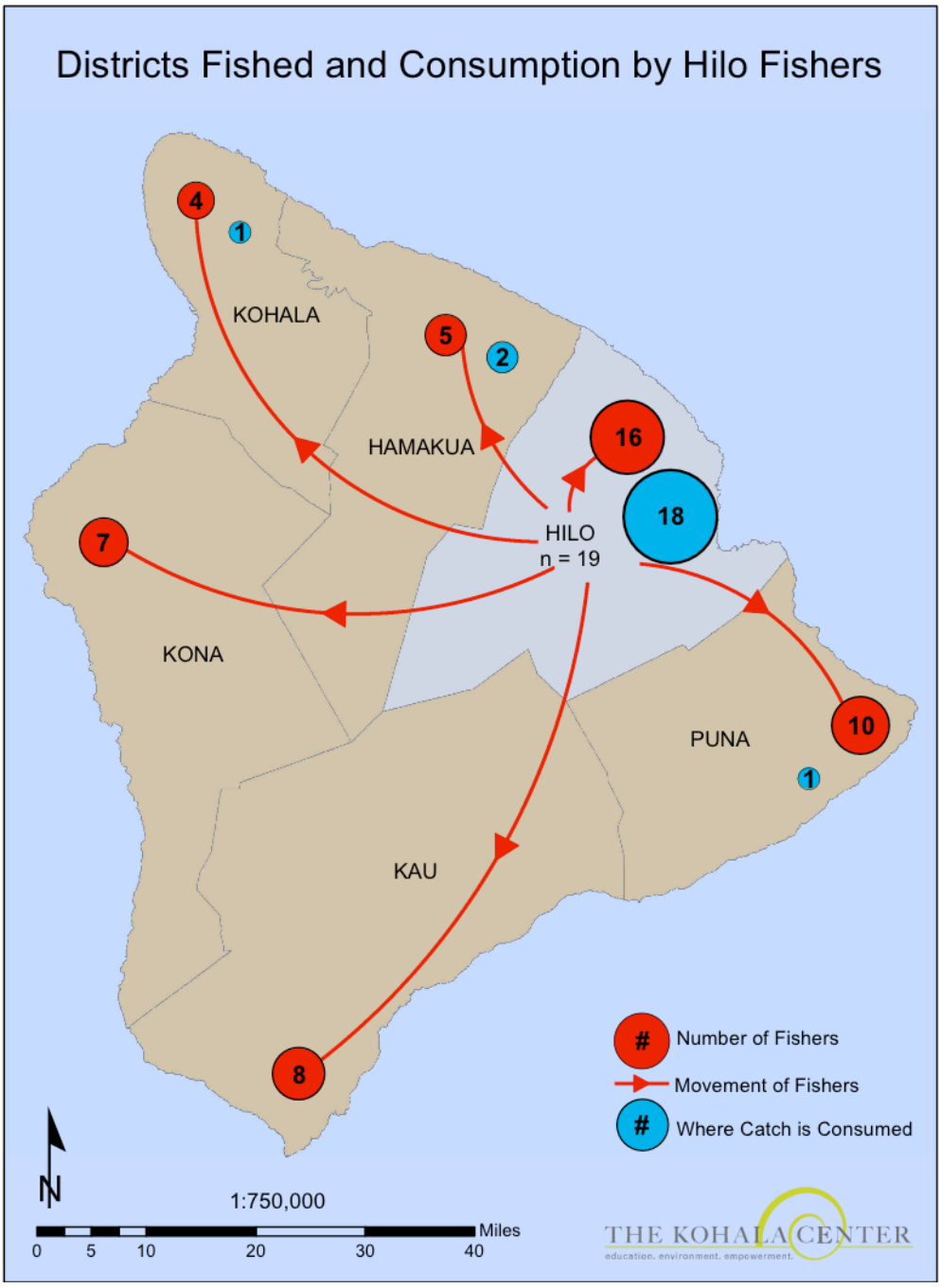

Figure 11. Flow of fish and fishers from Hilo to other districts.

of their home district, compared with Puna. Only one fisher consumed in Kohala or Puna districts (no catch was consumed in Kona or Kaʻu, despite nearly half the Hilo fishers fishing those districts), and only two described their catch as consumed in Hāmākua.

Similar to the east side, the majority of fishers in Kohala fished in that region or in Kona. No fishers from Kohala fished in Puna, but one did travel to Kaʻu, two to Hilo, and one to the Hāmākua coast. Similar to Puna, approximately half of all fishers consumed fish outside of their home district, (about 25% noted their catch was consumed in Kona, while two fishers described consumption of their catch in Hilo and another sent catch off island).

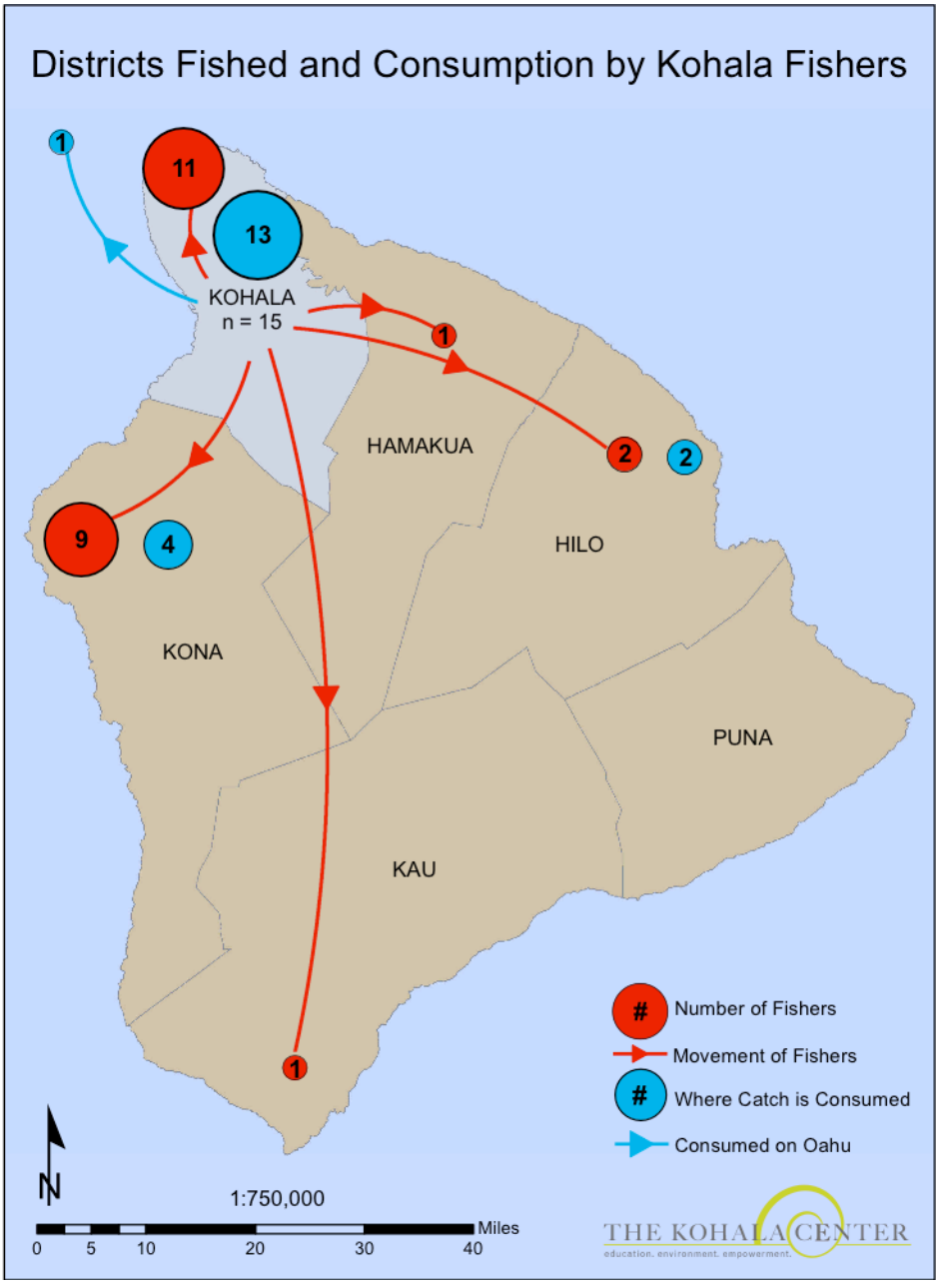

Figure 12. Flow of fish and fishers from Kohala to other districts.

The vast majority of fishers in Kona do at least some fishing in Kona and have their catch consumed in Kona. However, about one third of Kona fishers travel to Kaʻu and a quarter travel to Kohala to fish as well. Only two fishers (7%) from Kona included Hilo and only one mentioned Hāmākua as districts where they fished.

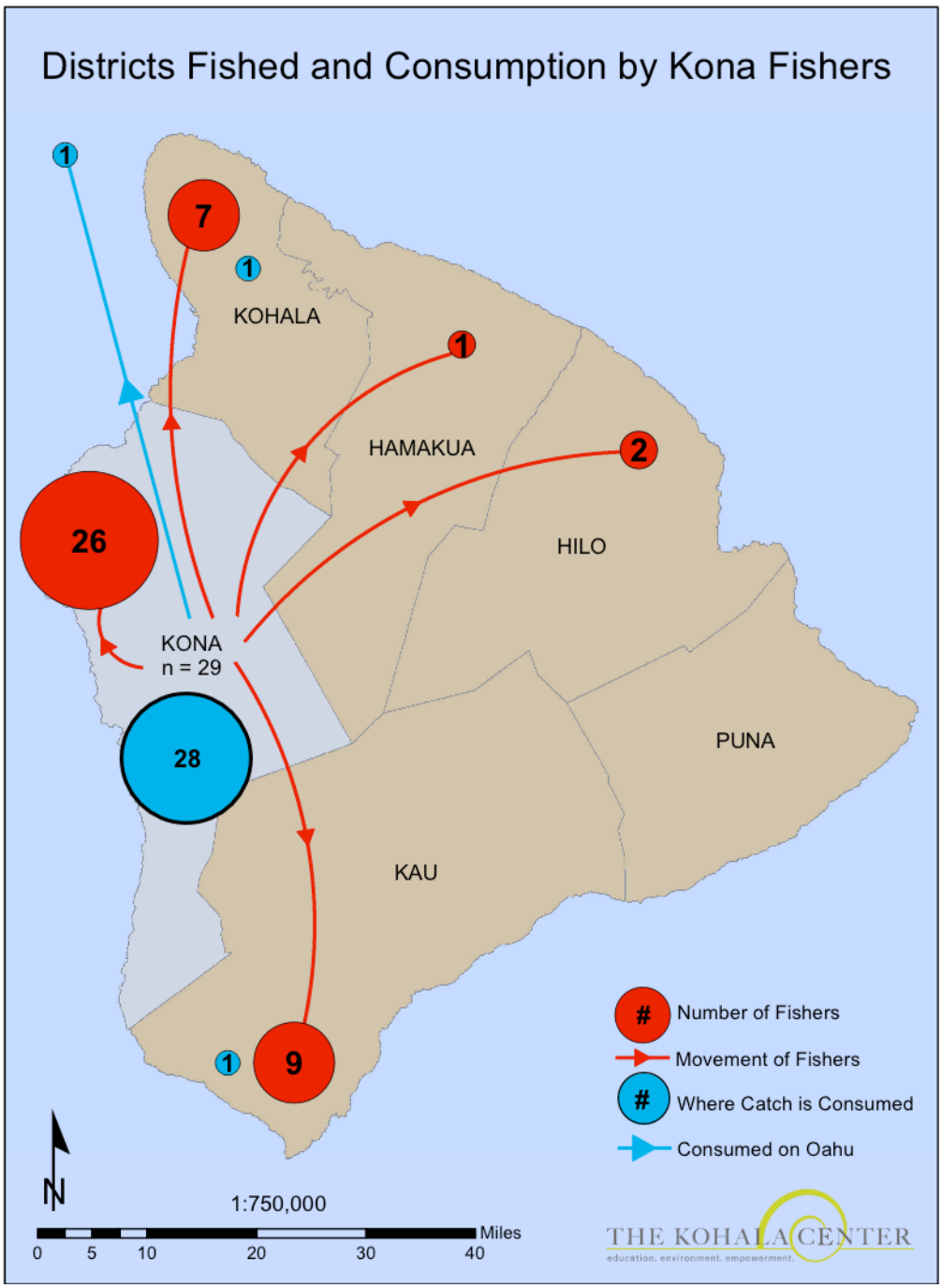

Figure 13. Flow of fish and fishers from Kona to other districts.

Similar to Hilo, very few Kona fishers described their catch as consumed in outside districts: only one fisher noted Kaʻu as a place of consumption, and one in Kohala. One fisher also mentioned sending their catch off-island to Oʻahu (to a friend).

Of the three fishers we spoke with from Kaʻu (only two are mapped), two included Kona as a fishing spot and one mentioned that they sometimes fish in Hilo. One fisher catches and eats (or shares) all his fish in Kaʻu.

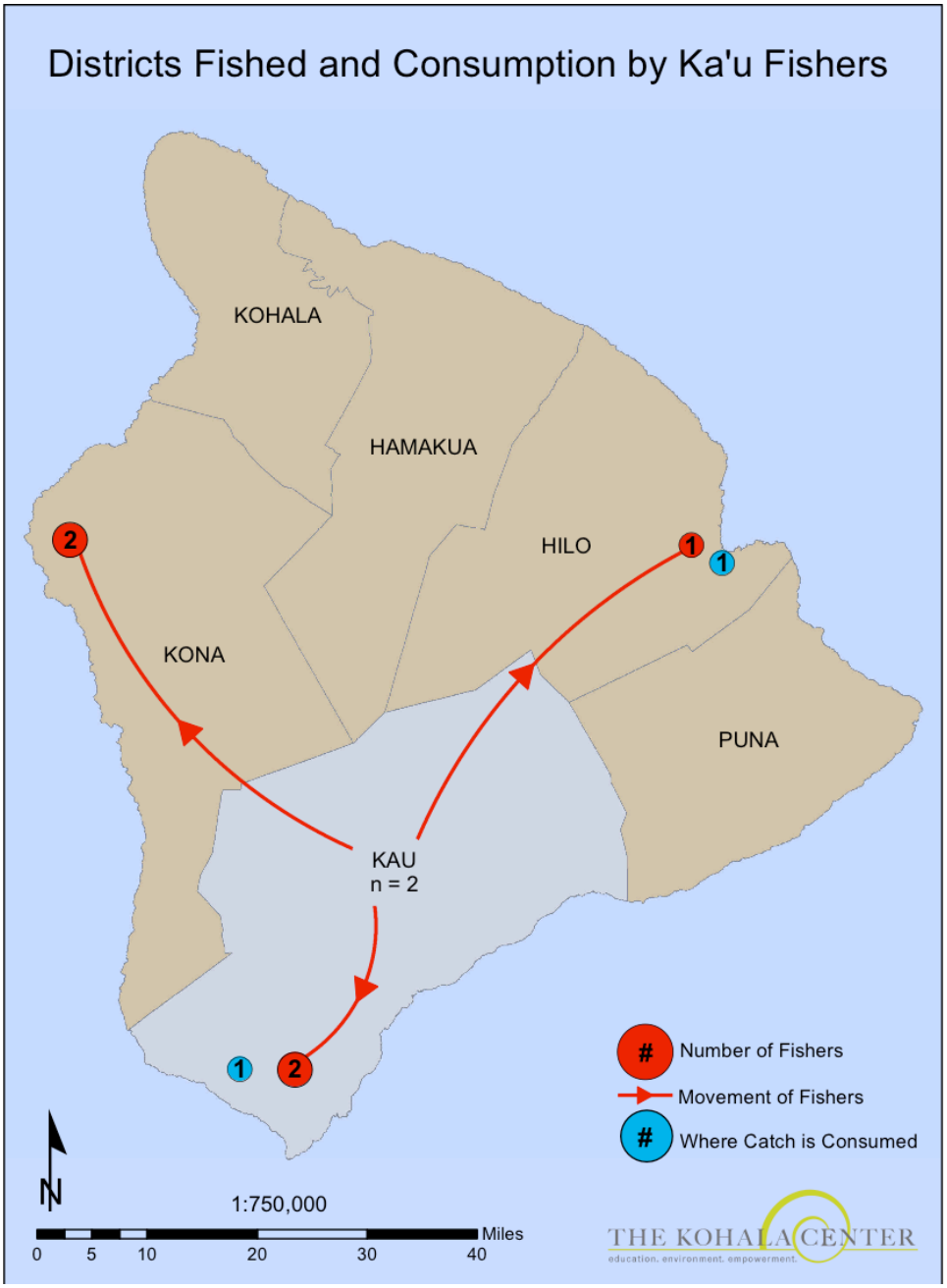

Figure 14. Flow of fishers and fish from Kaʻu to other districts.

There is clearly movement around the island of fishers and fish, but the vast majority of fishers continue to fish in their home district at least some of the time. The relatively small number of Kona fishers that go to the east coast is in contrast to the nearly 36% percent of fishers from Hilo that named Kona as a fishing destination. This information suggests that there may be more movement of fishers from the east side to the west than vice versa. And since Hilo fishers did not list Kona as a place of consumption, the fish they catch are moving west to east to supply people on the east coast.

This pattern of movement may be driven by shoreline fishers, especially spearfishers, who do not have cumbersome gear to tote around. Conversations with experts on local fishing communities brought to our attention the gear-level considerations that may be underlying the behavior—in other words, it may not just be access, but ease with which fishers can travel farther, that determines where fishers fish. To investigate this further, we mapped the flow of fishers by type of catch (pelagic, reef, both) and method (shore, boat, both) to look for any patterns (Figure 15-16 and A2-A21) .

Overall, we found that boat-only and pelagic-only fishers tended to stay in the home district or neighboring districts. Reef-only fishers tended to be the most wide-ranging for all districts. For Kona fishers, movement to Hilo was noted by reef-only (Figure 15) or shore only (Figure A11) fishers . For Kohala, reef-only (Figure A2) and shore and boat fishers (Figure A6) were the ones to go to Hilo. Puna had a similar, complementary pattern, with reef-only (Figure A16) and shore-only (Figure A17) fishers the only ones accessing Kona. On the other hand, in Hilo, both reef and pelagic fishers (Figure A9) and shore and boat fishers (Figure A10) traveled to Kona in addition to reef-only (Figure 16) and shore-only fishers (Figure A8). These observations suggest that, not surprisingly, flow of fishers is likely influenced by mobility of gear, with reef/shore based fishers less restricted in their travel than boat/pelagic fishers.

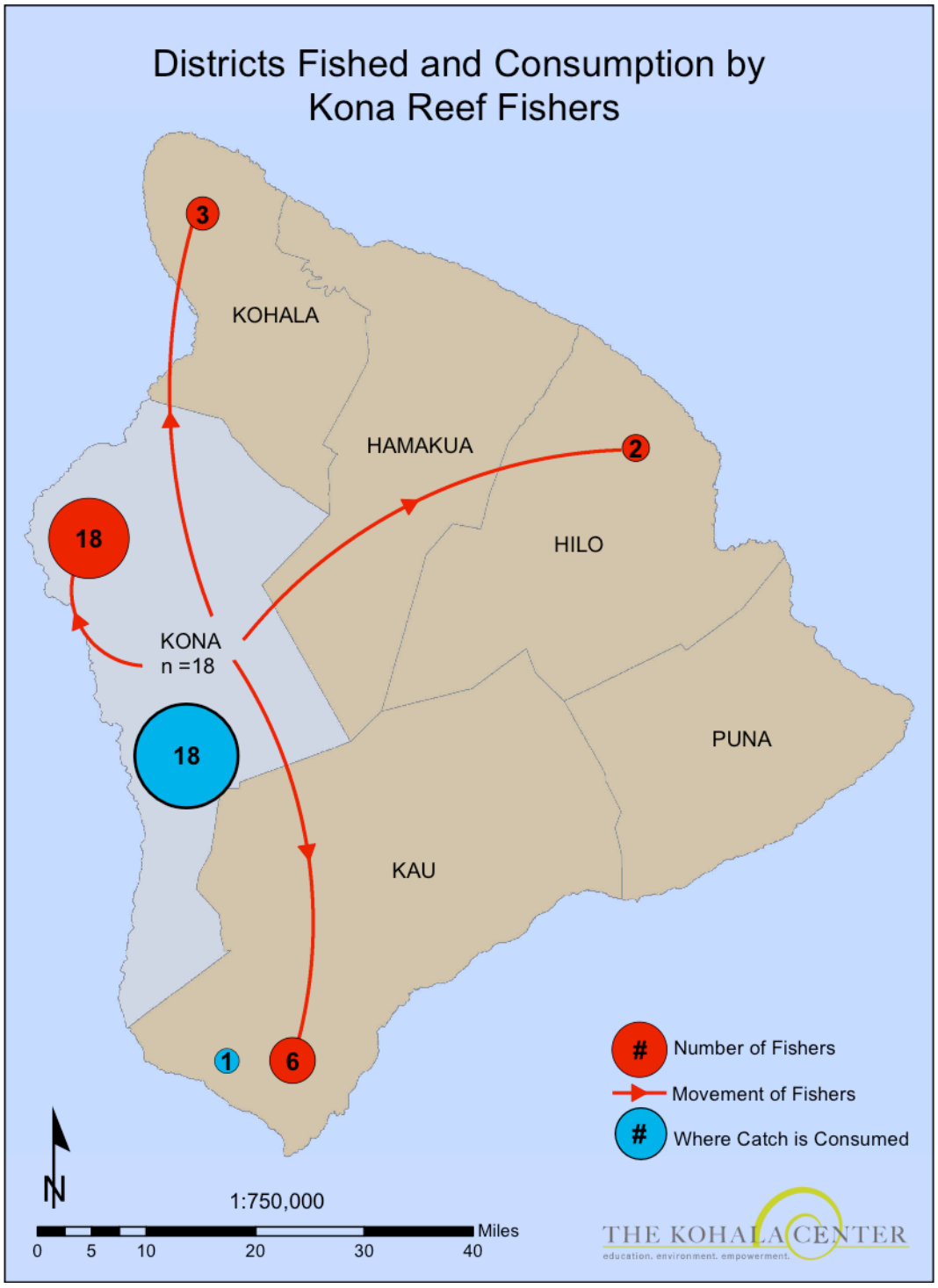

Figure 15. Flow of reef-only fishers from Kona to other districts.

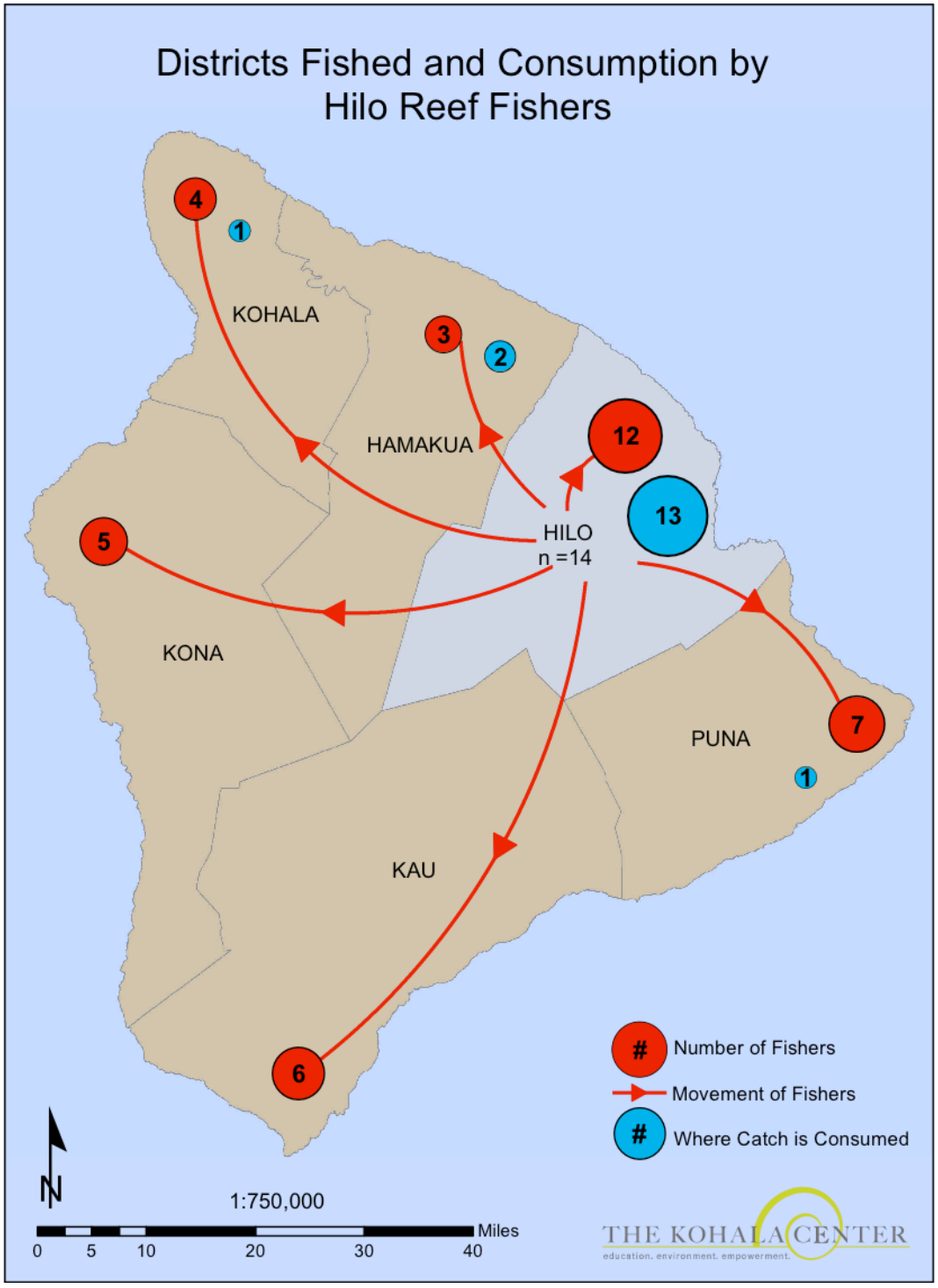

Figure 16. Flow of reef-only fishers from Hilo to other districts.

Although our data from Kaʻu is limited, over half the fishers from the east coast and nearly one third from Kona all go to Kaʻu to fish. Very few consume their catch there (or share their catch). This indicates that Kaʻu appears to be a source of fish for residents across the island, a perception held by one of the fishers we interviewed from Kaʻu, who stated that "Lots of people from other islands are coming into the fishing grounds, shoreline and boat fishermen from other islands and other parts of Hawaiʻi island."

On an island-level, the vast majority of fish is consumed either by the fisher or by the fisher's family and friends (Figure 17 and 18). Almost every fisher we spoke with shared some of their catch with people that they knew. Giving fish to those in the community who were in need, or could not fish themselves, was also a common pattern to emerge. At least seven fishers specifically mentioned "sharing with community and those who couldn't fish" or giving to "families that are struggling." From the elderly to single mothers, many fishers considered giving some of their catch as "the right thing to do" and a way to "give back" to the community.

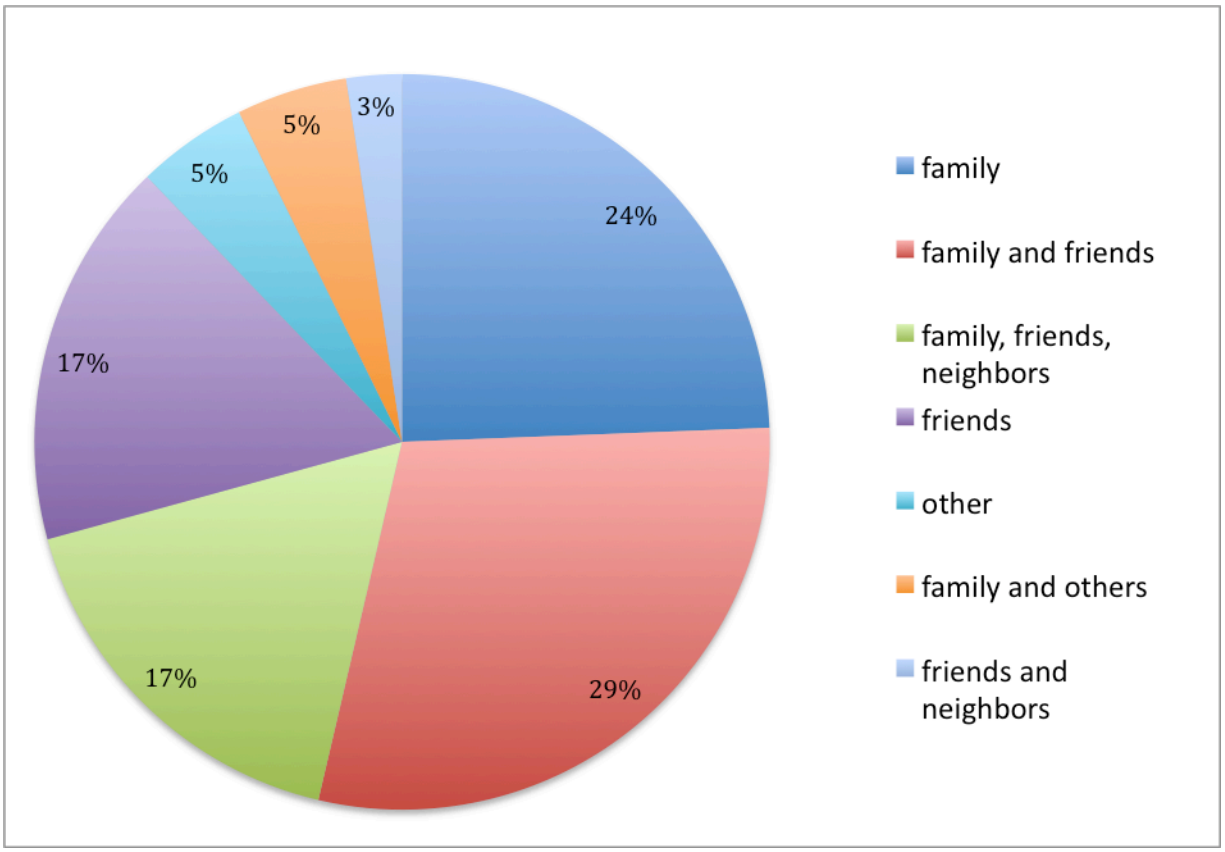

Figure 17. Destination of shared catch island-wide.

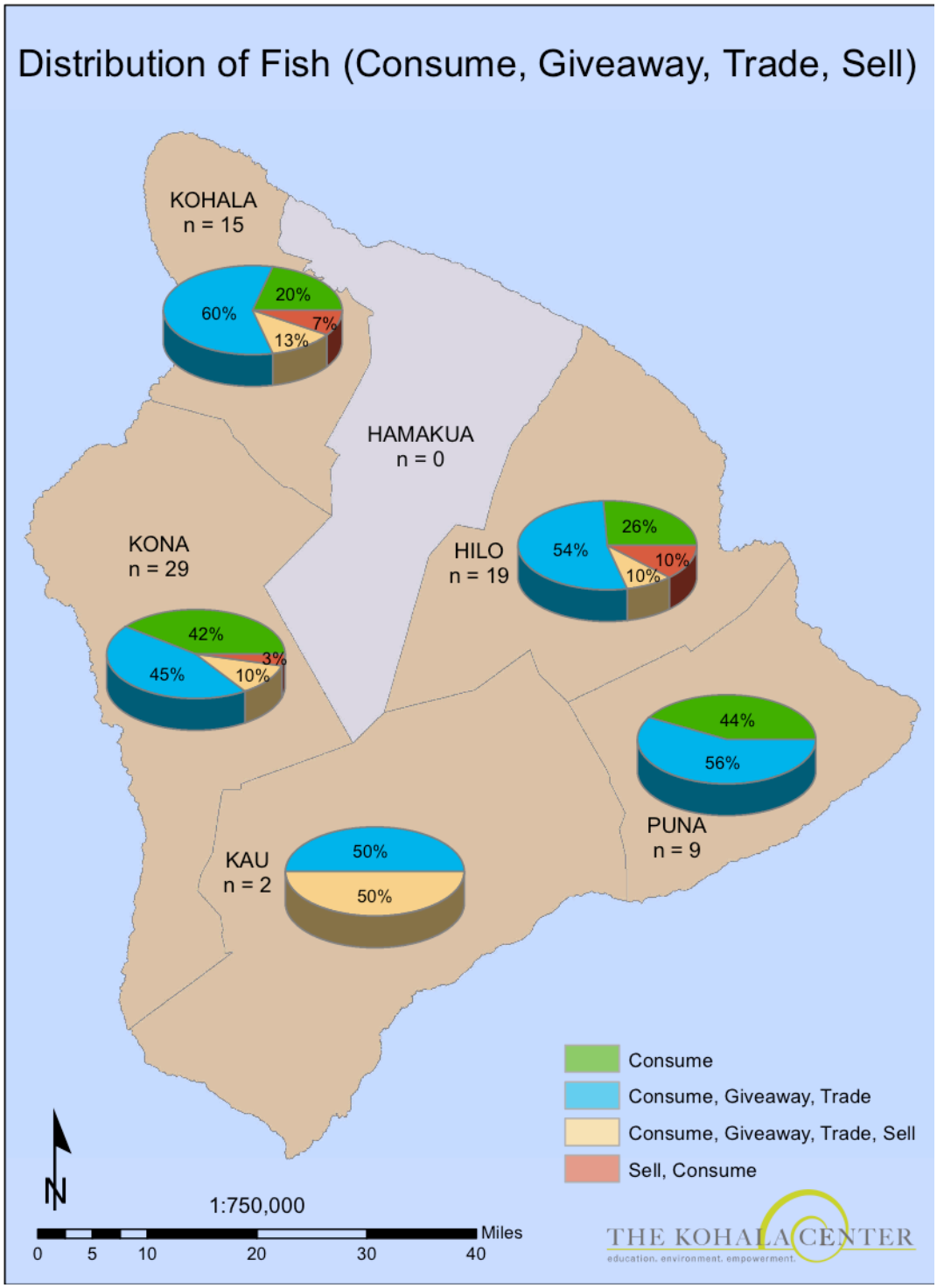

Figure 18. Types of trade by district.

Qualitative Analysis

We identified 6 major themes from amongst the 74 fisher interviews: Regulations/Monitoring; Education; Commercialization; Access; Long-term Perspective; and Other Culprits. Each major theme contained several sub-categories that highlighted different aspects of the general concern. We also made note of the different ways in which fishers tended to define themselves or their fishing practices, to help provide insight into how to best categorize the complex assortment that makes up fishers in Hawai‘i.

Theme I: Regulation/Monitoring

Regulations/Monitoring was the most prevalent theme, with half of all interviewees including some mention of regulations as the source of the problem or a need for improved/different regulations in order to curb the current declines in reef fish (Table 2).

Table 2. Regulation/Monitoring sub-categories, definitions, and prevalence. Prevalence of sub-categories is the percent of the 37 respondents that mentioned a specific sub-category within the Regulations theme: prevalence= (n/37)*100.

Theme	Sub-category	Definition	Number (Prevalence)
Regulations/ Monitoring		Any mention of state or federal laws, enforcement, data monitoring	37 (50%)
	Enforcement need	The mention of a need for more enforcement or a lack of enough enforcement; also, a recognition that enforcement is difficult	10 (27%)
	Ban SCUBA Spearing	Mention of the need to ban spearfishing on SCUBA	4 (10.8%)
	Ban Nighttime Spearing	The need to ban nighttime spearing; one case specifically mentioned for uhu	4 (10.8%)
	License/Permits/Limits	Desire for more licensing, permits, or limits	4 (10.8%)
	No License/Permits	Disapproval of any new licensing or permits	2 (5.4%)
	MPAs good	Approval or support of protected/closed areas/zones	7 (18.9%)
	MPAs bad	Disapproval of closed areas as management tool	3 (8.1%)
	Bag limit	Desire for limits on total take of some species	2 (5.4%)
	Size limit	Desire for more/different limits on legal size	4 (10.8%)
	Seasonal closure	Desire for more seasonal closures/support of seasonal closures	3 (8.1%)
	Data	Need for better/more data to base regulations upon including the need to integrate traditional Hawaiian knowledge	3 (8.1%)

The need for greater enforcement was the most prevalent issue expressed by all interviewees. There appears to be a general acknowledgement that enforcement officers are too few and far between to make a difference. The result is that the regulations in place are often worthless because of a large amount of rule-breaking that goes on unpunished.

A key finding was that discussions of enforcement often included discussions about education (Theme II). Some believed rule-breaking was simply a matter of people being uninformed about regulations, as “lots of times the poaching is ignorance.” Others argued that the only practical

way to enforce regulations was for individuals to be their own enforcers, and this required educating individuals about *values,* not just which rules existed (see Table 3).

Several individuals argued that teaching the next generation of children was therefore critical to addressing this issue. Others argued that the state needs to replicate structures that exist elsewhere, such as Alaska, and ramp up funding to support a team of enforcement officers that would be a real presence on the shorelines and in the water. Along with this philosophy was a tangential insight that increasing the punishment was paramount to shifting the behavior of fishers towards compliance: "We need to make example—sorry to say it—of people who break the law, and then people will be more respectful because they will know others are watching."

"The entire budget for DLNR marine is less here than that in Wyoming! And they only have streams and lakes. We are surrounded by ocean!"

"We must educate our children to be good stewards. Children then become their own enforcers…we would not need DLNR or DoCARE."

When it came to licensing, there were mixed responses. Three of the four respondents who mentioned a need for permitting wanted this applied only in a restricted sense (and each wanted to target a different group: commercial fishers, recreational fishers, or non-residents). Two fishers were strongly opposed to any licensing system for reef-fishers.

There was some consensus, however, when looking at components of the regulatory system that were already in place. Nearly half of all respondents concerned with regulations supported one or more of the types of regulations currently in use, including closed areas (nearly 19% of respondents supported), seasonal closures, size limits, and bag limits. These individuals expressed support of such measures and/or a desire for increased use of these tools for more species/more locations.

There also appears to be a strong belief that spearfishing is one of the most harmful forms of reef fishing, contributing to declines. This observation is based on the multiple fishers who argued for bans on nighttime spearing and SCUBA-spearfishing (combined total of 21%). Nighttime spearfishing appeared to be linked more to commercially based activities: "[We] need to stop nighttime reef divers—they fill 3–4 coolers full because it is so easy…They all sell to Honolulu and make a killing spree of it from North Kona/S. Kohala to south point. Few guys do a lot of damage because if catching to sell, they will take everything." From 2008–2009, State Commercial Marine License reports show that approximately 81,000 pounds of fish were reported as caught using diving/spear on Hawai'i Island, and about 54,400 of that was reef fish (primarily uhu, lobster, and menpachi). It may be worth determining how significant this take is

compared with local reef productivity, and how much of this is caught at night or on Scuba. See more discussion of this issue under Theme III: Commercialization.

There were also four individuals who said they did not take state regulations into account, and fished according to what their customs/traditions were in terms of size or catch limits.

Theme II: Education

As mentioned in the Regulation section, Education was another prevalent theme to arise out of this study (Table 3). Twenty-seven percent of all interviewees noted that education (or lack of education) was an important factor in determining future health of coral reef fisheries. The need for more education was clearly expressed by the majority of interviewees, but what kind of information they believe needed to be shared varied among respondents.

Half of the individuals expressed concerns that in general, fishers were unaware of the basic natural history of the reefs, and the importance of things such as breeding seasons, size for maturity, and other factors that can greatly affect population dynamics. “You see the coolers all full of fish with eggs, but if you approach the fishers, they get angry and say ‘you can’t tell me how to fish. I’ve fished this way my whole life.’ They just don’t know.” The logic behind this sub-category is that if fishers understand why certain regulations were in place, this will hopefully lead to greater compliance. One fisher took things a step farther though, and argued that “Lots of education is needed, showing the community that these things [different kinds of management tools] have worked in other places, because the community doesn’t want an ‘experiment’ in their own backyard.” In this case, it is the responsibility of the regulators to not only teach the logic behind the laws, but to provide success stories to indicate that the sacrifices fishers will make are worth it.

Table 3. Education, sub-categories, definitions, and prevalence. For sub-categories, prevalence is the percentage of the 20 respondents within the education theme that referred to a specific sub-category

Theme	Sub-category	Definition	Number (Prevalence)
Education			20 (27%)
	Natural History	Need to educate people about fish life cycles, how our actions affect the reef, how management works	10 (50%)
	Values	Instill conservation/sustainability ethic/ long-term perspectives	8 (40%)
	Traditional Hawaiian Knowledge	Includes education on traditional Hawaiian management approaches and integrating this knowledge with modern management	6 (30%)
	Lack of information	Need to educate individuals about what kind of rules exist/ disseminate information better especially to certain ethnic groups	3 (15%)

About half of the fishers who wanted to see more natural history education also wanted to see greater emphasis on teaching values. As discussed in the regulations theme, there is a strong belief that teaching fishers to view the reef as a resource to be conserved is the only way that sustainability can be reached: "We really need to educate the next generation that this is a sustainable resource if we do it right. That is the only way we will get there." Phrases such as "the ocean is our icebox," "take only what you need," and "think about the long-term consequences of our actions" were common in this sub-category. In some cases, fishers argued that such lessons needed to be shared with adults, while other fishers emphasized the need for teaching the next generation of fishers (who in turn, could influence their parents).

Almost as popular was the call for traditional Hawaiian knowledge to be more thoroughly integrated into modern management. This sub-category often blended with the previous two, arguing that Hawaiian moon calendars (seasonal closures) offered insight into appropriate regulations while the concept of "taking only what you need" was a value adhered to by cultural practitioners. For example, one fisher who identified himself as a cultural practitioner

remarked that "how much you get depends upon what is available, and you take only what is correct amount given that. Everyday we are practicing, watching areas."

Finally, a few fishers noted that although rules and regulations were publically available, there was a lack of access to this information for new fishers in the community, especially certain ethnic groups. There was concern that fishers from outside Hawai'i, where restrictions were not inherent to their culture, were not only unaware of the restrictions here, but unaware that regulations even existed. Finding new channels for communicating this information to a wider audience was viewed as critical by some participants.

Theme III: Commercialization

There was a strong sense among fishers that selling fish for profit was at the heart of the overfishing problem (34% of interviewees). Sixty-four percent of respondents concerned about commercial fishing were against sale of fish because it was perceived to lead to overfishing, or were against it simply in principle (Table 4). "The problem is perspective—people now thinking about how much something is worth, not in terms of how much do I need, how many people can be fed by this, but instead they think in terms of dollars. That is the heart of the problem, when we shifted from a resource to a currency-based economy."

These views are complicated by the fact that some fishers offset the cost of their own fishing by selling their catch and therefore view commercial selling as an integral part of their own fishing practice. More often than not, however, the fish they sold were pelagic, and not reef fish. This points to the complexity of defining a fisher in Hawai'i (Glazier, 2007). The same person will sometimes fish for reef fish for themselves, but, especially if they are using a boat, they may troll or handline for pelagics in order to offset the gas cost. Alternatively, there were a few fishers who focused on catching and selling pelagics, but occasionally would also fish for reef fish (but not sell those). Approximately 8% (n= 6) of the fishers we interviewed mentioned that they sold fish to offset costs, and four of those six sold pelagics.

Table 4. Commercialization, sub-categories, definitions, and prevalence. For sub-categories, prevalence is the percentage of the 23 respondents within the commercialization theme that referred to a specific sub-category.

Theme	Sub-category	Definition	Number (Prevalence)
Commercialization		Any form of selling fish for money—this does not include trade or exchange	23 (33.7%)
	Against	Philosophically against the idea of selling fish for profit	6 (24%)
	Cause of declines	Idea that the profit motive incentivizes fishers to overfish	9 (36%)
	Ban sale to outside markets	Against commercial selling of local fish off-island	1 (4%)

State level data for Hawai‘i Island shows that nearly 54,000 pounds of reef fish were sold on average in 2008–2009 and that reef fish are caught and reported from all districts. Our study provides evidence that in Hawai‘i, reef fish are sold “informally” by individuals who go door-to-door or sell to restaurants “under-the-table” (Chinese restaurants were specifically mentioned). Four interviewees specifically mentioned that they knew people who sold reef fish (or *‘opihi*) to O‘ahu, but that this trade was not always reported. The lack of any large market for reef fish in restaurants or retail outlets here in Hawai‘i supports the evidence that reef fish are either exported to O‘ahu or sold in more informal arrangements: “People who want to eat reef fish here go and catch it themselves.” However, it is important to note that we did not interview any fishers who considered themselves “commercial” reef fishers, and therefore, we are missing the details on that channel of trade.

As shown in Figure 5, no fishers that we spoke with were classified as commercial reef fishers, and less than 10% claimed to be commercial and non-commercial reef fishers in any district. Further investigations into the volume of reef fish that passes through these channels would greatly benefit a more holistic understanding of the Flow of Fish on Hawai‘i Island, and the role that commercialization plays in supporting lifestyles and/or impacting the reefs. Two ways to do this might be to build upon the network of contacts established in this study and to dig deeper into those local outlets that do sell (or serve) reef fish.

Theme IV: Access

About one-quarter of fishers mentioned that access (either too much or too little) was a problem. The majority (55%) believed that the "free for all" was a primary driving force of overfishing. These fishers saw the increased ease of access to the shoreline as facilitating increased pressure on the reefs from too many fishers. "It is harder now to catch. Before we needed 4WD to get there and it was so abundant at that time that we could be picky with our catch…But now I don't see those days anymore."

Another fisher remarked that "when I was younger, access to the ocean was difficult so not many fishermen were on the shores." Another summed it up this way: "If a car can go, no more fish." In general, the sentiment was that places that had more difficult access (such as the Hāmākua coast) were thought to have more fish; places that were easy for fishers to get to as well as others (tourists, surfers, snorkelers), had fewer fish. Sometimes, areas of multi-use also caused problems because fishers couldn't get to their resource. For example, it was noted that people visiting the shoreline would often urinate on the rocks where families used to gather food.

On the other hand, five fishers argued that access was too restricted. This viewpoint was held by fishers who believed gated communities and private developments had cut off access to traditional fishing spots: "we are supposed to have gathering rights but just you go and try to collect in some places—they'll arrest you for trespassing."

However, limited access was not always the result of developments—two fishers remarked that they were excluded from some fishing spots by "locals" who would not let them come and fish. One fisher described an incident where he asked if he could fish in a place where nobody was fishing at the time, and the older men there said he could not because they were "saving" the spot for a friend.

What is interesting about this latter perspective is that it reflects a deeper cultural tradition where fishers ask permission before going to fish outside of their own home areas. This practice is still observed by many, and was mentioned by 3 interviewees as a fundamental aspect of being a "*pono*" fisher. In the case above, it is not clear if the fisher was outside his home district, but clearly asking permission was not enough to gain access.

Theme V: Long-term Perspective

This theme reflects an awareness of the importance of sustainability or long-term thinking within fisheries. This awareness was evident in the reasons why fishers did certain things, or was stated directly, such as the fisher who said, "It's not like Costco, it's not an endless supply of fish. If we don't take care now, we won't have fish later." Some fishers mentioned that they no longer fished for certain species because they were aware the fish were in decline (uhu was mentioned in particular). Others noted that it was more important than ever to only take what you need: "take my one fish and I go home."

Overall, this theme captured the perception among fishers that changes have occurred on the reef and there is a need for a long-term perspective in order to achieve more sustainable use of marine resources (Table 5). Of the 74 fishers interviewed, 26 (35%) noted some form of declines on the reefs. These statements ranged from a general "there are just not as much fish as before" to "I have to fish farther out than before" to "Spiny lobsters and ʻĀweoweo have declined." Fishers put forth many different reasons why they thought these declines had occurred (see Theme VI: Other Culprits) but only 13 fishers made reference to a need for more sustainable practices. The disparity of twice as many fishers noting declines as those who noted a need for more long-term sustainable practices is worth noting.

In addition, it is interesting that over two thirds of fishers acknowledged changing their behavior because of declines while 50% stated that there was a lack of awareness regarding best practices for the reef (see Theme II: Education). Clearly, there is a disconnect between those fishers who are informed (or claim to be) and their perception of other fishers as not. Further discussion about what factors contributed to fishers changing their practices (i.e., what made them aware and motivated to shift behavior) may help elucidate a means of educating others.

Table 5. Long-term perspective, sub-categories, definitions, and prevalence. For sub-categories, prevalence is the percentage of the 13 respondents within the commercialization theme that referred to a specific sub-category.

Theme	Sub-category	Definition	Number (Prevalence)
Long-term Perspective			13 (17.6%)
	Sustainability Important	Acknowledgement that sustainability (use of the word) is important	4 (31%)
	Practice sustainability	Fisher made comment referring to limiting their take or altering their behavior because of the long-term	9 (69%)

consequences

Theme VI: Other Culprits

This theme was the "blame" category—any and all theories on who or what was the source of declines in reef fish or observed changes in marine resources. Like all other themes, information pertaining to this category was given mostly during the open discussion sessions where we asked "is there anything else you think is important for us to know, or observations you would like to share related to marine resources/fisheries on Hawai'i Island?" Approximately 36% of fishers interviewed provided some form of explanation within one of a dozen categories (Table 6).

Table 6. Other culprits, sub-categories, definitions, and prevalence. For sub-categories, prevalence is the percentage of the 27 respondents within the commercialization theme that referred to a specific sub-category.

Theme	Sub-category	Definition	Number (Prevalence)
Other Culprits		Reasons that interviewees gave for noted declines or problems with fisheries that were not related to a specific regulation (i.e., type of fishing method)	27 (36.5%)
	Pollution	Comments regarding increased pollution, or decreased water quality	6 (22%)
	Invasive species	Most notably ta'ape and roi	4 (15%)
	Aquarium fishers	Those fishers who target tropical reef fish for aquarium trade—not food	4 (15%)
	Immigrants	Mention of "outsiders" or specific cultural groups as cause of the problem	3 (11%)
	Special Occasions	Tournaments, Lū'au, parties, etc., that were mentioned as fueling excessive and/or wasteful catch	3 (11%)
	Drugs	Mentioned as driving force behind people fishing harder than normal	2 (7.4%)
	Technology	Increased efficiency of gear driving declines	2 (7.4%)
	Habitat loss	This was in regard to coastal development	1 (3.7%)
	Turtles	Perception that there are too many turtles now because of protected status	1 (3.7%)
	Illegal FADs	In the context of pelagics, these are	4 (15%)

the illegal private buoys

Interesting to note is that despite the current tensions with the aquarium trade fishers, they were only considered a source of the problem by 4 interviewees. An equal number blamed invasive species (primarily ta'ape and roi) as contributing to declines in native fish. The most popular culprit was pollution, which included references to runoff from golf courses. One fisher commented that regulators should "take out the houses that dump all the sewage and kill the reef, not the fishermen."

Special events, such as *lū ʻau* and tournaments were also seen by three fishers as occasions where fish were wasted. The same number of fishers also viewed increased fishing by "immigrant" populations to be a problem, and included both those individuals who lived on Hawaiʻi Island and those that came in from other islands just to fish.

Four fishers were concerned about the health of pelagic species and noted that increases in private and illegal FADs were a significant concern and potentially causing changes in fish distributions. Also of concern for pelagic fish populations were "foreign" or "longline" fleets which are perceived to hunt down all the fish before they can get into nearshore waters.

Two fishers also raised the point that improvements in technology were problematic, with divers now having longer, faster spears, "camo" wetsuits, big fins, SCUBA tanks, etc. "Fish don't have a sporting chance." Another fisher noted that regulations need to adjust as technology adjusts.

References to the connection between drug use and fishing were made by only two individuals but note a potentially interesting larger-scale driver of change on the reefs. As a free and open-access system, anyone can turn to fishing as a means of securing cash on short notice. Drug addicts who cannot hold jobs can still go fishing in order to raise funds to support their addiction.

Even though many "external" factors were given as contributing to the declines, many fishers not only acknowledged overfishing as a problem, but admitted that their own communities were as much a source of the problem as "other" groups.

Defining Fishers

As has been noted, defining "types" of fishers proves a difficult task due to the complex and fluid behavior of fishers. When asked why they fish, respondents gave a diversity of reasons including for fun, food, tradition, exercise, sport, relaxation, experience, survival, and income (Table 7). The vast majority of fishers often provided several of these reasons, citing that why

they fished changed depending on the season, circumstances in their job/life, or simply how they felt on a particular day.

Table 7. Motivation, sub-categories, definitions, and prevalence. For sub-categories, prevalence is the percentage of the 27 respondents within the commercialization theme that referred to a specific sub-category.

Motivation	Number of fishers
Fun	10
For Food (not dependent)	19
Subsistence (depends on fish for food)	3
Enjoyment/Relaxation/Recreation	4
The experience	6
Challenge/sport	6
Exercise	2
Tradition/Culture/Community	14
Work	1

As managers look for ways to label fishers in order to assign specific rules and regulations, it will be important for the regulatory system to include room for these more fluid fishing categories. Licensing and permit systems that provide more subtle and creative categories may prove more effective at generating support within the community, as opposed to those that seek to pigeon-hole fishers into the traditional "recreational" and "commercial" groups that do not appropriately describe the majority of fisher behaviors here on Hawai‘i Island.

Other Seafood Sectors

As noted in the methods, we also interviewed 42 individuals from across different seafood sectors and academia. This data deserves a more detailed analysis than can be provided here, but a summary of some of the major insights is presented below:

Pelagics, pelagics everywhere as a result of ciguatera scare. Restaurant owners, chefs, and seafood purchasers ("buyers") all dealt almost exclusively with pelagic species (ono, ʻahi, and mahimahi were the most common, with marlin, opah, and spearfish also commonly mentioned). The most common explanation given for this limited scope of species was the fear of ciguatera poisoning, which is known to exist in reef fish, but not open water swimmers. In addition, familiarity with the fish also contributed to the decision of buyers to stick with a more limited palate than the ocean (and fishers) could offer. For example, one chef explained that he was from the Mainland, and didn't know reef fish, how to prepare and cook them, and because his clientele were mostly tourists (Kona district) he didn't see much demand for reef fish.

Even retail outlets where they catered to more local-based consumers (for example, choosing to carry more "rats"—the 2–3 pound tunas favored by some cultural groups), they avoided carrying too much reef fish because of the risks associated with ciguatera. Several buyers noted that the market was there, in that they knew some people liked reef fish, but that it was not worth the risk to carry them. In all our visits to retail shops, we saw very few reef fish available for sale.

Transactions require personal relationship building. Many of the transactions between fisher and buyer were initiated by phone as the fisher made their way to shore. Fishers asked the going price and if a buyer was interested in their catch, and a verbal agreement was arranged. There were no cases of any written transactions to note the initial price negotiation. This is why development of personal relationships may be so key to the trade—buyers described having "regular" fishers that they knew well and trusted who they preferentially sourced from. And, although things were done relatively "informally," professionalism was highly regarded by several of the larger retail purchasers and many of the chefs/restaurant owners.

Although there were strong personal relationships, depending on the size of the establishment, some buyers had lists of hundreds of fishers' CMLs who they have purchased fish from. Clearly, the retail and restaurant sale of pelagics supports a significant number of local fishers, including supplementing charter boat captains and crew. This particular situation has created tension between commercial fishers and charters. Hawaiʻi is one of the few states where charters can

sell their catch. Commercial fishers argue this leads to a flooding of the market, decrease in price, and an unfair squeeze on the fishers.

Buyers hold all the power. The next stage in the transaction was notable, as it revealed the power the buyers have over the fishers. Fishers bring their fish to the buyer and although a price has been agreed upon, the buyer gets to inspect the fish for its quality. This is especially true with ʻahi. This inspection often includes cutting open the fish to see if it is "burned"—something that cannot be determined from external examination alone. However, this examination is not done in front of the fisher, but behind "closed doors" of the buyer. The fisher is then stuck accepting the buyers' verdict, and potentially lowered price.

Most buyers we spoke with said they always asked for the CML license in order to record and report on all transactions to the state. However, some admitted to helping out a local fisher or two who they knew personally who did not always have a license (such admittance supports the idea there was some trust between interviewer and interviewee).

Buyers determined their prices by comparing with wholesalers, and knowing the prices of their competitors. Price could be negotiated but for many buyers, they argued they did not have time for extended deal-making, and thus, stuck with fishers who trusted they would provide a fair price. Some buyers mentioned that they would give better prices to their fishers so that when it was low season, the fishers would be loyal and bring them their catch for that same price.

Wholesalers fill a gap. Many buyers supplemented the local supply direct from fishers with supply from wholesalers. This was done to meet demand and ensure a stable supply, though the majority voiced a preference for direct purchasing. The exceptions to this were a few outlets that had concerns about health and safety, and for insurance reasons went through a wholesaler.

There are several wholesalers on the island and it would be interesting to further explore their role in stabilizing supplies for retailers and restaurants. Fishers definitely made clear they preferred to sell to end-buyers rather than wholesalers/distributors because prices were not as good with these middlemen. However, when the fish were running, sometimes wholesalers were the only ones buying.

Fish flow is uneven through time and space. In terms of time, is no surprise that sometimes the market is flooded with fish, while other times chefs are scrambling to find enough fillets to fill the plates. The former situation tends to happen more than the latter, however, according to the individuals we spoke with. In terms of space, fishers are limited with how far they can travel to find a buyer once they have landed their fish. This means there are times when demand

might not be met, not because the supply doesn't exist, but because the supply can't get there. Further examination of how more cooperative or community-based distribution systems could work to secure markets for fishers while help stabilize supply for buyers (and bring fresh local catch to a more diverse/wider geographic region) could prove beneficial.

Areas of Opportunity

Both the quantitative and qualitative data provide rich context for discerning areas of opportunity for future work. The goal of this study was to provide greater understanding of how fish are caught and distributed around Hawai‘i Island with the hope that such knowledge would provide insights into how more efficient, effective, and sustainable practices could be incorporated into the system.

What We Learned

The Flow of Fish project was an exploratory initiative that utilized existing network connections and expanded upon them in order to explore more intimately the knowledge, perceptions, and motivations of fishers on Hawai‘i Island. As is always the case when speaking with experts, our job was to listen and synthesize the various opinions, thoughts, and perspectives provided by the diverse fishers that granted us audience. This glimpse into the fishers' world is by no means comprehensive and we continued to learn throughout the process. Below is our attempt to sift through this rich media of ideas and highlight some of what we found to be promising leads for future development.

Insight I: Education and Enforcement Are Strongly Linked. Conversations about enforcement were inherently mixed in with discussions about education, especially the recurring mention of the need to educate individuals so that they could take more responsibility themselves. The idea that ignorance or a lack of conservation awareness drives much of the transgressions is supported by conversations we had with government officials, who commented that first-time offenders often genuinely did not know the laws. The result was that often these fishers would get a warning and the officer would educate them about the rules.

This close link between education and enforcement supports notions that communities may be ripe to take on an enforcing role by providing education, and starting with the younger generation may be a promising approach. For example, one fisher described how he "saw an old lady in Punalu‘u sitting and scraping all the *‘opihi* off the rocks. Even the small ones. But she didn't know [that was wrong]. But I couldn't tell her. Need her *kids* to tell her." Other fishers also mentioned that teaching children the values was the best way to get their parents to learn. Another strength to this approach is those fishers who were taught values as children (often by their own parents or grandparents) held onto those values throughout their lives. So teaching

children now may be a way of providing a new generation of educated, aware adults for the future.

This concept is especially relevant given the guarded and often hard-to-penetrate information networks of fishers, especially across different ethnic groups, which makes dissemination of rules or values difficult to achieve. Children, on the other hand, congregate in schools, after-school programs, and camps, where it may be easier to educate many at once.

Exploring how to link education and enforcement within and across communities could provide a way of increasing enforcement levels outside of state budget limitations while providing empowerment to the community.

Insight II: Access as a non-monetary incentive. Many fishers expressed some form of the idea that "the reef isn't something to make money off of, it is there to feed us." Historically, the Hawaiian economy was based on a trade system and this practice of giving away or trading catch is still in full force today. Therefore, models that can identify or create non-monetary incentives for more sustainable fisheries may have greater buy-in from communities than currency-based approaches. Given the perception by several fishers that too much or too little access creates barriers to sustainable fishing, providing communities with the means for moderating access may prove a strong non-monetary incentive for encouraging more sustainable fishing behaviors/practices. Such an approach would inherently require some level of co-management with regulatory agencies but could provide a community-based management structure that helps to alleviate enforcement burden on the state.

Insight III: Distribution is uneven and there is a latent reef fish market. Although the number of fishers from each district is too low to draw any definite conclusions, the data suggests that there may be more movement of fishers from east to west, and especially from other districts into Kaʻu. This implies that fish from the west and south point may be supplementing the diets of residents across the island, and not just in nearby districts. In addition, fishers repeatedly noted that sharing the catch with those in need within their communities was an important aspect of their fishing practice. Several noted that they shared especially with the elderly or working professionals who could no longer fish for themselves.

These findings, taken together, suggest that there may be an opportunity for developing a more efficient distribution system to serve this latent market for reef fish among those who are in need or can no longer fish for themselves. Such a distribution system would need to provide easy access for fishers and consumers, and be structured in way that *did not* increase pressure on the reefs but instead facilitated the distribution of catch already being shared, but in a more

efficient and effective manner (the system could also be tied to endeavors such as fish ponds which increase production of reef fish). The system could also fill the gap in the way that current wholesale companies do—serving as a central depot from which to redistribute fish in a manner that helps stabilize supply. However, as a cooperative-type endeavor, the profits from this redistribution would be redirected back towards the fishers and community, rather than serving as a simple "middleman" mark-up. Such a system offers the potential to create jobs and provide better tracking of fish flow data to facilitate more accurate monitoring and management.

A community-based distribution system for the commercial pelagic trade is also worth exploring for similar reasons.

Insight IV: Intention, more than catch, defines fishers. For many of the fishers we spoke with, fishing is not about catching lots of fish, or the biggest fish. Instead, it is an experience that connects the individuals with their cultural heritage, with the natural world, with an opportunity for growth and challenge, or with an escape from the daily grind. When discussing why they fished, fishers in this group told us things such as: "I was born and raised here, this is what I know. Fishing is my life. A big part of my life." Others said it was "a great way to get a balance and good therapy."

In these instances, the catch itself is of secondary importance, "I don't go because I want to eat, mostly I go because I want to fish; I want the experience." Fishers in this category may offer more flexibility in terms of the kinds of rules and regulations that are applied, for it is the experience of fishing and not the catch itself that is the driving force behind the activity. For others, fishing is truly a subsistence activity, a "survival mode" that either provides food or something to trade for other daily necessities. Limits on take for these individuals will have much greater consequences than the previous group described, and therefore warrant particular consideration within the law.

Such a wide-ranging set of motivations demands a more colorful approach to management than the typical black and white commercial/recreational divide that currently governs the resource. Further investigation into a more sophisticated and representative classification scheme could provide an opportunity for communities to participate in their own self-identification as fishers, and present alternatives to regulatory agencies for a more effective enforcement structure.

Insight V: Commercial sales lack transparency. Several fishers involved with commercial sales lamented the loss of the auction block on island because it has led to a lack of transparency in

the market. Now, fishers must deliver their fish to the buyer and wait while the buyer inspects the fish—behind closed doors. The buyer is thus in full control of the negotiations, leaving the fisher with little power—he or she must accept whatever condition the buyer reports the fish to be in, and take the price offered. An open trade forum, such as an auction, allows fishers and buyers to interact on more level playing field as each fish is publically displayed and examined. Introduction of some kind of centralized, public space for commercial sales would help to balance the power between fisher and buyer and could help to provide more fair price negotiations.

There is current legislation being considered to explore feasibility of a fish auction on Hawai'i Island—integrating the findings of this study into that research would be beneficial.

Insight VI: Show the Success Stories. Education, as has already been discussed, is likely a strong potential opportunity for creating change. However, there was a particular sentiment expressed by some interviewees that points to a slightly different angle on education than has previously been discussed, and it dovetails with some novel approaches to problem-solving that are occurring across the globe for all kinds of complex systems—from women's health to global fisheries. That is, the importance of showing and learning from success stories. There are two benefits to gathering information and becoming familiar with the success stories that already exist: 1) Communities are more likely to agree to adopt certain approaches if they have been tried and tested in other geographic regions or similar contexts ; 2) We can learn from what has already worked in other places to discover what may work best here. Thus, although Hawai'i has some unique components to its fisheries, gathering information about successful initiatives (from MPAs, to Community Supported Fisheries, to co-management structures, to different kinds of aquacultural) and presenting these stories to communities, may be extremely beneficial to building trust and formulating effective strategies for future development.

Final Thoughts

The insights presented here represent the seeds of ideas sparked by over a hundred hours of interviews. They are meant to serve as launch pads for invigorated discussion around the future of sustainable fisheries on Hawai'i Island. As such, we did not examine in detail the viability of each insight and we expect the ideas to evolve and change as future discussions occur. Our hope is that this project is just the beginning of a more extensive exploration of creative solutions to reef fisheries management that will draw from the wealth of knowledge inherent in the community of producers, buyers, and consumers of seafood that live here. We also hope that our method of approach and analysis will help open pathways for continued conversation and trust between researchers and fishers for future projects here and elsewhere around Hawai'i.

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Appendix included as separate document available for download at www.kohalacenter.org or www.hawaiifish.org.

Research Team

Dr. Marah J. Hardt, Project Manager. Marah is founder of OceanInk (www.oceanink.org), a consulting company focused on finding creative solutions to ocean conservation issues through research, writing, and strategic problem-solving. She has a background in coral reef ecology and historical marine ecology and has worked on a diversity of conservation challenges, from sustainable seafood to climate change.

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Dr. Guy Kaulukukui, Strategic Design and Administrative Support. Formerly the Associate Director for Strategic Partnerships at the Kohala Center, Guy is now Deputy Director of the State of Hawaii Department of Land and Natural Resources.

Dr. Kathryn Besio, Social Science Advisor. Kathryn is an Associate Professor of Geography at UH Hilo. She is researching the foodscape of Hawai`i Island, particularly the intersection between Local food/cuisine, home gardens, locally sourced foods, and Local identities.

Dr. Donna Delparte, GIS Advisor. Donna is an Assistant Professor with the Department of Geography and Environmental Studies, University of Hawaii at Hilo. She specializes in Geographic Information Systems (GIS) and its application in natural and social sciences.

Dr. Fiona McCormack, Social Science Advisor. Fiona is an Assistant Professor of Anthropology at UH Hilo and collaborated via her course in Marine Anthropology, helping advise students on research projects that included interviews used in the Flow of Fish study. Her research concerns transformations in property and ownership structures—with an expertise in Maori fisheries, and she is now developing a comparable research focus in Hawaii.