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WHITEFISH:

TRADITIONAL ECOLOGICAL KNOWLEDGE AND SUBSISTENCE FISHING IN THE KOTZEBUE SOUND REGION, ALASKA

By

SUSAN GEORGETTE AND ATTAMUK SHIEDT Technical Paper No. 290

Division of Subsistence Alaska Department of Fish and Game Kotzebue, Alaska

> Maniilaq Association Kotzebue, Alaska

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COVER PHOTOGRAPH: Dolly Custer of Shungnak cuts whitefish at a fish camp on the upper Kobuk River, September 2002. (James Magdanz photo)

ABSTRACT

Whitefish are a key subsistence resource in the Kotzebue Sound region, one of the few fish available to every community in any abundance. This report documents traditional ecological knowledge and subsistence fishing of whitefish in a sample of communities representing different ecological areas in the Kotzebue Sound region in northwest Alaska. The study covered five species of small whitefish: broad whitefish Coregonus nasus, humpback whitefish Coregonus pidschian, least cisco Coregonus sardinella, Bering cisco Coregonus laurettae, and round whitefish Prosopium cylindraceum. A total of 57 individuals, mostly Iñupiag elders, were interviewed between 2002 and 2004 in Kobuk, Kotzebue, Noatak, Noorvik, Selawik, and Shungnak. Topics covered by these interviews and summarized in this report include the following: Iñupiaq taxonomy of whitefish (species available, their characteristics, and their local names); distribution, seasonal movements, spawning, and feeding habits of whitefish; observations on whitefish abundance and health; interactions of whitefish with other animals; traditional lore; subsistence fishing practices by community; and the processing, storage, and preparation of the whitefish harvest. Estimates of whitefish harvests from secondary sources are also included. The interviews brought to light previously undocumented details about whitefish, one of the values of a small, focused study such as this.

Key Words: Bering cisco *Coregonus laurettae*, broad whitefish *Coregonus nasus*, Cape Krusenstern National Monument, humpback whitefish *Coregonus pidschian*, Iñupiat, Kotzebue Sound, least cisco *Coregonus sardinella*, Noatak National Preserve, round whitefish *Prosopium cylindraceum*, Selawik National Wildlife Refuge, traditional ecological knowledge.

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I INTRODUCTION

The purpose of this study was to collect traditional ecological knowledge on whitefish in a sample of communities representing different ecological areas in the Kotzebue Sound region in northwest Alaska, known also as the Northwest Arctic. The project addresses the need to document traditional Iñupiaq knowledge of fish resources as an initial step towards incorporating this knowledge into biology-based fisheries management. Fish are the region's most reliable subsistence resource, and a major component of contemporary subsistence harvests. Key species include chum salmon, sheefish, Dolly Varden, and whitefish. Of these, whitefish is the only one available to every community in any abundance. Despite its significance as a key subsistence resource, whitefish have received little attention from scientific researchers until recently.

Whitefish belong to the family of salmonids, along with grayling, trout, char, and salmon. Eight to ten or more species of whitefishes are found in Alaska, with the number depending on how some forms are classified (Mecklenburg, Mecklenburg, and Thorsteinson 2002). Six of these are present in northwest Alaska's Kotzebue Sound region: sheefish Stenodus leucichthys, broad whitefish Coregonus nasus, humpback whitefish Coregonus pidschian, least cisco Coregonus sardinella, Bering cisco Coregonus laurettae, and round whitefish Prosopium cylindraceum (Uhl and Uhl 1977; U.S. Fish and Wildlife Service 1993). This project covered the latter five species of small whitefish. The sixth species-sheefish or inconnu—is by far the largest whitefish in the region, and is distinct from the smaller whitefish in many aspects of its natural history and subsistence harvest and use. For this reason it was not included in the scope of this study. Previous research by the Division of Subsistence, Alaska Department of Fish and Game, documented subsistence use of sheefish by upper Kobuk River residents in the late 1980s (Georgette and Loon 1990).

Management issues concerning whitefish have received considerable public discussion in recent years. Among these was a proposal by the Northwest Arctic Regional Advisory Council to allow whitefish nets to completely block streams, a traditional



Figure 1-1. Humpback whitefish before processing. Iñupiaq people harvest thousands of whitefish every year from the waters of the Kotzebue Sound region.



James Magdan

Figure 1-2. An Iñupiaq elder set this small-mesh gillnet fully across the mouth of Kuutchiaq (Kuicherk River) near Shungnak in June 2003. Whitefish sets like this are a common and traditional practice, but were prohibited until recently. A proposal from the Northwest Arctic Regional Advisory Council to legalize the practice was opposed by some agency biologists. fishing technique in certain circumstances. This proposal generated substantial debate among resource managers and subsistence fishermen, with little information available in the literature to aid in the discussion. A second long-standing management issue involves local concerns over the impact of increasing beaver populations on whitefish. In recent decades, beaver have been expanding westward in the Northwest Arctic region, moving into new areas and increasing in number in existing habitat. A third management issue is the possibility of renewed interest in a small-scale commercial whitefish fishery, similar to the one that took place in Selawik in the mid-1980s.

In recent years, traditional ecological knowledge, or TEK, has been increasingly recognized as a legitimate field of environmental expertise. Freeman (1992) makes the following observation about TEK:

Many scientists have begun to understand that traditional knowledge extends far beyond what in western science would

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be called descriptive biology. . . . The knowledge possessed by such tradition-based, non-industrial societies is essentially of an "ecological" nature, that is to say, it seeks to understand and explain the workings of ecosystems . . . and the role played by certain key biological and physical parameters in influencing the behavior of the total biological community.

Freeman goes on to discuss other strengths of TEK, including its approach to understanding ecological complexity through a holistic, systemic, intuitively-generated analytic way, rather than through reductionism and the linear process of cause and effect common in the scientific method. TEK recognizes that even if it were possible to know everything of importance under all possible permutations, working with such an immense database would in practice be impossible. Freeman states:

Linear approaches to analysis cannot be applied to cyclical systems, and, as everyone now realizes, ecosystems are in fact complex cycles. . . . Nowhere does the Cartesian model of modern science fail so completely and utterly as in trying to explain the workings of natural ecosystems.

With these strengths, TEK has much to offer in the study of whitefish ecology in the Kotzebue Sound region.

Existing literature describes various aspects of the subsistence harvest and use of whitefish in the Northwest Arctic region. Burch (1998) explains the important role of whitefish in the 19th century seasonal rounds of many of the Iñupiaq nations of northwest Alaska. For example, he describes the following for the lower Selawik River people, who were particularly dependent upon fish:

In mid- or late July, while the whitefish were still in the small lakes, people built fences of stakes, brush, and moss across the sloughs. This effectively trapped the fish in the lake. Below the first fence they built another with a hole in it. . . . A funnel-shaped trap was inserted in the hole. . . .

In early August the whitefish began to run out of the small lakes to the large lakes and rivers. But wherever people had constructed weirs the fish could not get past the first fence. After a week or two hundreds or even thousands of whitefish were jammed up against the fence trying to get out. At this point, the first fence was removed. The fish rushed down the slough only to get caught in the trap. They were removed from the trap with large dip nets.... Sometimes the fish could be caught by hand and just thrown out.

Subsistence studies in the 1970s in the Kobuk River communities, Noatak, and the Cape Krusenstern area documented other aspects of the harvest and processing of whitefish (Anderson, Anderson, Bane, Nelson, and Towarak 1998; Uhl and Uhl 1977, 1979). In early summer after spring flood waters recede, Kobuk River residents set gillnets in sloughs and lake outlets to catch

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whitefish. Gillnets are also used in early summer in coastal areas near Kotzebue to catch whitefish. Along the Kobuk River, gillnetting for whitefish continues throughout much of the summer. In the fall, seines are used by Kobuk River and Noatak residents to harvest large quantities of whitefish. At this time of year, seining is the most productive method of fishing because whitefish gather into large, densely packed schools, river conditions are favorable, and cool weather provides ideal conditions for drying and storing large numbers of fish. After freeze-up, Kobuk River residents set gillnets under the ice for whitefish. This continues through late October or early November when thickening ice and reduced fish movements make fishing less productive.

One of the more unusual harvest techniques for whitefish occurs in the Cape Krusenstern area northwest of Kotzebue. Lagoon systems in this area create giant natural fish traps that local residents have long exploited. In early summer whitefish move along the coast and into the outlets of these lagoons, where they spend the summer. By middle or late summer, wave action and coastal currents close the lagoon outlets by transporting beach gravel along the shoreline, effectively impounding large numbers of whitefish. Uhl and Uhl (1977) describe the resultant harvest technique:

The stage is set for possibly one of the world's most simple effective fish exploitation procedures. A simple three-foot wide "irrigation" ditch is dug in the porous gravel 20 feet long with a 10-foot diameter circular "stomach" on the end away from the edge of the water. The level of the gravel is graded downhill so that a good current flows out, but as the water progresses down toward the ocean, it seeps through the gravel and leaves a dry floor in half of the circular "stomach."...

The whitefish feels the pull of the strong current at the head of the ditch and after finning against the current for a time, it turns tail and rides the current toward the circular "stomach." It loses water depth all the way until . . . finally all of the fish's body is exposed and it flops on its side, gasping until the maker of the . . . trap stuffs him in a . . . sack . . . and puts the fish away to be eaten frozen sometime in the coming nine months of winter season.

Throughout the region, whitefish are dried, aged, baked fresh, or eaten as *quaq* (frozen fish, often aged). Along the Kobuk River, different cutting methods are used at different times of year for drying whitefish (Anderson et al. 1998). In the Noatak area, one of the roles of whitefish is described in some detail by Uhl and Uhl (1979):

Whitefish and char have a much greater range in the Noatak watershed than the salmon. They can be expected in the extreme reaches of all small tributaries, often in isolated pools not connected to main channels during dry spells. They are important as a



survival food for those traveling in isolated mountain areas during the summer as a part of the population seems to travel upstream instead of downstream soon after spring flood time. Many of the whitefish migrating downstream are taken by the Noatak people at their spring camp at Sisualik in June and July for drying.

Many other sources have documented other aspects of whitefish fishing. For instance, Jones (2003) describes in excellent detail the processing, cooking, and storing methods for fish in the Kotzebue Sound region. In an earlier publication Jones (1983) writes about various traditional food preparations for berries, several of which involve whitefish. Magdanz (2004) presents interesting tidbits on whitefish fishing in oral narratives of elders' lives in the upper Kobuk. Anderson and Anderson (1977) discuss historic and pre-historic whitefish fishing sites in an archeological study in the Selawik area. Giddings (1956, 1961) describes traditional fishing techniques for whitefish, such as weirs and traps, in the upper Kobuk River area. Burch (1998) lists many 19th and 20th century Iñupiaq settlements whose location was based on proximity to good whitefish fishing. Some information from these sources is included in the text of this report.

Quantitative data on whitefish harvests are available for selected communities. Comprehensive subsistence harvest surveys con-

Figure 1-3. A ditch, or qargisaq, for catching whitefish at Anigaaq near Cape Krusenstern, September 2003. Thomas Williams watches his father, Sam Williams, maintain a ditch in the beach blocking the outlet of the Krusenstern Lagoon system. The use of ditches is an ingenious, simple, and very effective whitefish harvest method unique to the coastal lagoons near Kotzebue.

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Susan Georgette

Figure 1-4. Whitefish drying in a cache, Shungnak, September 2002. These humpback whitefish were partially dried in a camp, then brought back to Shungnak to finish drying in a covered cache. ducted in Deering, Kivalina, Kotzebue, and Noatak in the 1990s showed that 40 to 60% of households in these communities used whitefish during the study year (Alaska Department of Fish and Game 2001a). Annual surveys in the Northwest Arctic region to document subsistence salmon harvests have also recorded harvests of whitefish. For the six Kobuk and Noatak River communities, whitefish harvests have ranged from about 40,000 to 85,000 fish during the years 1997 to 2003 (Georgette, Caylor, and Trigg 2004). Additional harvest information on whitefish is presented in chapter 5 of this report.

Whitefish are clearly a significant food source in the Kotzebue Sound region. Although some aspects of whitefish harvest and use have been described, little has been written on Iñupiag knowledge of the natural history of whitefish. Whitefish have complex patterns of movement, migrating between spawning and wintering areas and moving between various feeding areas in summer. Some species are anadromous. These movements are only understood at a general level by biologists. Many of the details of these movements, along with the location of spawning areas and trends in abundance, are particular to local areas and remain undocumented. This study is intended to gather localized knowledge on the ecology of whitefish as understood by Iñupiaq fishermen in a sample of communities in the Kotzebue Sound region. This will pull together a valuable body of information that will be useful to local communities and to fishery managers. It may also serve as a basis for directing further scientific inquiry on whitefish.

Objectives

- 1. Collect Iñupiaq knowledge of whitefish, including life history, ecology, seasonal patterns of movement, taxonomy, interaction with beaver, long-term trends in abundance, and traditional conservation practices.
- 2. Generate maps depicting important whitefish habitat and subsistence fishing areas in the vicinity of study communities.
- 3. Convert traditional ecological knowledge (TEK) information into a useable computer-searchable database.
- 4. Provide experience to community residents in the collection of traditional ecological information.
- 5. Train Maniilaq Association staff and tribal staff in use of the database.

2 Methods

This project was a cooperative effort between the Division of Subsistence, Alaska Department of Fish and Game (ADF&G); Maniilaq Association; and Selawik National Wildlife Refuge, U.S. Fish and Wildlife Service (FWS). Approval to conduct the research was obtained from the tribal councils in the study communities. The project followed accepted standard methods of TEK documentation outlined by Miraglia (1998) and described more fully below. The research was conducted in accordance with the Principles for the Conduct of Research in the Arctic.

While the bulk of the research presented here was carried out under the FIS 02-040 project, additional portions of it took place through contracts and agreements with other funding sources. Preliminary work in Selawik occurred in 2001 and 2002, funded by the U.S. Fish and Wildlife Service, Selawik National Wildlife Refuge under contract number 701811C063. Research in the upper Kobuk River communities of Shungnak and Kobuk took place in 2002 and 2003 in a parallel project funded by the National Park Service, Gates of the Arctic National Park and Preserve, under cooperative agreement number H9840020057. Preliminary findings from these studies were summarized in Georgette (2002, 2003). To expand the depth and coverage of the current FIS project, these complementary studies have been incorporated into this report in both the methodology and findings sections. Unless otherwise stated in this report, "this project" refers to these combined research efforts.

The primary data collection method for this project was interviews with individuals in the following sample of communities in the Northwest Arctic region: Kobuk, Kotzebue, Noatak, Noorvik, Selawik, and Shungnak. Key respondents were identified with the help of community assistants and tribal office staff and through the researchers' own knowledge of the area. All respondents were life-long or long-term residents of the region, and nearly all were Iñupiaq. Most continued to be active in fishing at the time of the interviews, although a few were retired from fishing due to their age or health.

The investigation plan for this project proposed that 5 to 10 indi-



Figure 2-1. Elder key respondents. Emma Ramoth of Selawik (top) and Vera Douglas of Shungnak (bottom) were among the 57 key respondents interviewed during this study.

METHODS



Figure 2-2. Hannah Loon of Selawik assisted the authors with Iñupiaq spellings and terminology, shared her knowledge of fishing, and reviewed the final report. She also organized several successful culture and science camps for

school children in Selawik. September 2003.

viduals would be interviewed in each study community. Shungnak and Kobuk were paired together as one study community because of their close proximity and shared environment, culture, and family ties. The number of interviews met or exceeded this estimate. A total of 57 individuals were interviewed in depth: 9 in Kotzebue, 11 in Noatak, 11 in Noorvik, 13 in Selawik, and 13 in Shungnak and Kobuk combined. Some of these individuals were interviewed on multiple occasions. The interviews took place between January 2002 and June 2004. Respondents included both men and women, ranging in age from 39 to 88 years old. The largest group of respondents (40%) was in their 70s; 26% were in their 60s, 18% in their 80s, and 16% under 60 years old. The names of respondents, their year of birth, and dates of the interviews are listed in Table 2-1. All these individuals have spent most of their lifetimes gaining detailed knowledge of and expertise in fishing, hunting, and gathering niqipiaq (Iñupiaq Native food) from the land. Those most knowledgeable often were raised by their grandparents or grew up in camps and continued to spend time there as adults. Age alone, while significant, was not the chief determinant of a respondent's depth of knowledge.

In addition to those listed in Table 2-1, numerous other individuals informally contributed information to the project: for Noatak, Joe and Mary Arey, Nora Booth, Priscilla Booth, and Jonah and Eunice Walton; for Kotzebue, Kat Keith, Ross Schaeffer, Sr., and Thomas Williams; for Noorvik, Pauline Cleveland; for Shungnak, Barbara Armstrong, Edna Commack, Dolly Custer, Leonard Douglas, and Wynona Jones; and for Selawik, Walter Berry, Ingram and Mary Ann Clark, Roger Clark, Elsie Dexter, Hannah Loon, Clyde Ramoth, Ralph Ramoth, Sr., Ruth Sampson, and Edith Snyder.

Interviews utilized a semi-structured format outlining general areas of discussion and developed in advance by ADF&G and Maniilaq Association staff. These interview guides were adapted to conditions and circumstances in each community, and thus varied slightly from one another. Appendix A includes examples of two interview guides, one for Selawik and one for Kotzebue. The guides were primarily an aid to the interviewer for directing the conversation, and not a progression of questions asked to every respondent. The content of each interview varied depending on the respondent's knowledge and experience and on information already documented through previous interviews in the community. Photographs of the whitefish species were shown to respondents to aid in identification and to provide a visual prompt. This proved quite effective, particularly because most respondents were only familiar with the Iñupiaq names for whitefish.

Methods

Respondent's Name	Birth Year	Interview Dates	Respondent's Name	Birth Year	Interview Dates
Kobuk			Noorvik (continued)		
Rose Custer ¹	1914	March 2002	Minnie Morris	1927	March 2004
Amelia Gray	1916	July 2003	Angeline Newlin	1947	March 2004
Nina Harvey	1935	July 2003	Edith Pungalik	1935	March 2004
Rosie Ward	1946	July 2003	Martha Smith	1936	March 2004
		,	Hazel Snyder	1921	March 2004
Kotzebue					
Herbert Foster, Sr.	1932	March 2004	Selawik		
Frank Greene	1945	January 2004	Grant Ballot	1942	April 2002
James McClellan	1937	February 2004	Violet Cleveland	1944	April 2002
Sally McClellan	1939	February 2004	Hannah Davis	1930	February 2002
Augie Nelson, Sr.	1939	April 2004	Mildred Foster	1940	January 2002
Bob Uhl	1927	September 2003 March 2004	Bert Greist	1950	January 2002 March 2004
Carrie Uhl	1922	September 2003 March 2004	Emma Ramoth	1937	January 2002 June 2002 June 2002
Sam Williams, Sr.	1927	September 2003	Ionas Bamoth	1930	June 2003
Morris Wilson Sr	10/1	March 2004	Pauline Ramoth	1930	February 2002
	1941	March 2004		1900	June 2002 June 2003
Noatak			Laura Smith	1926	April 2002
Dwight Arnold, Sr.	1924	February 2003, February 2004	Roy Smith	1925	April 2002
Mary Arnold	1927	February 2003	Jackie Snyder	1946	January 2002 February 2002
Philip Booth	1935	February 2003	Charlie Tikik, Jr.	1952	January 2002
Thurston Booth	1955	February 2003	Magdeline Tikik	1919	January 2002
Wendell Booth, Sr.	1930	November 2002 February 2004			
Gladys Mitchell	1937	February 2003	Shungnak		
Robert Mitchell, Sr.	1929	February 2003 February 2004	Mildred Black	1933	April 2003 July 2003
Paul Norton, Sr.	1940	February 2003	Levi Cleveland	1933	January 2003 March 2004
Herbert Onalik, Sr.	1916	February 2003	Buth Cleveland	1931	January 2003
Victoria Onalik	1918	February 2003		1001	March 2004
Ben Sherman, Sr.	1943	February 2003	Sophie Cleveland	1927	April 2003
			Larry Custer, Sr.	1937	January 2003
Noorvik			Vera Douglas	1926	September 2002
Aggie Black	1924	March 2004			January 2003 March 2004
Ivan Field, Sr.	1933	March 2004	Magdalene Lee	1930	April 2003
Ramona Field	1935	March 2004	- Bertha Sheldon	1923	January 2003
Ruth George	1928	March 2004	Margaret Sheldon	1929	January 2003
Dorcas Jackson	1932	March 2004	Josephine Woods	1929	April 2003
Lloyd Morris	1965	March 2004			

TABLE 2-1. NAMES OF KEY RESPONDENTS, BY COMMUNITY.

¹ Rose was interviewed by Jim Magdanz and Jonas Ramoth as part of another research project called *Kobuk River Human-Land Relationships*. Whitefish information from that interview is included in this report.

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Overall the interviews covered the following types of information: taxonomy (species utilized and local names for fish species); seasonal movements of whitefish; spawning and wintering areas; harvest methods (contemporary and traditional); timing of harvest; fishing areas; relative abundance and population trends; impact of beaver on whitefish populations; and traditional stories. Every interview did not cover every topic, and individual respondents were more familiar with some topics than with others. Many of



Figure 2-3. Clyde Ramoth of Selawik, one of the project's community assistants, contributed to the research in many important ways. He assisted with interviews and field logistics, guided researchers to fish camps, and offered insights into the community. June 2004.

Susan Georgette

the interviews naturally digressed to other topics, particularly to other fish species and to stories about the respondents' lives. The researchers personally knew many of the respondents, which added context and shaped the tone and content of the interviews.

Local residents assisted with most of the interviews, nearly all of which took place in the respondents' homes or fish camps. Respondents were paid an honorarium of \$50 to \$200 depending on



James Magdanz

Figure 2-4. Project field work, September 2002. Fannie Woods (left) and Susan Georgette (right) visit at Qalugriivik, the Woods' family camp on the upper Kobuk River. Humpback whitefish dry on racks in the background. The water was very high; normally the rack in the background would be on a sandbar well above river level.



Susan Georgette

Figure 2-5. Biological field work in Selawik, June 2003. FWS biologist Randy Brown and graduate student Melissa Robinson take whitefish samples with the assistance of Selawik children Pauline and Emil Ramoth. A separate biological research project occurred concurrently with the TEK project. Researchers from both projects traveled together to Selawik fish camps on several occasions to explore biology and traditional knowledge of whitefish. the length of the interview. Ten of the interviews were recorded, while in the rest researchers took hand-written notes. The recorded interviews were transcribed, and interview notes were typed and edited. There were several reasons why only a few of the interviews were recorded. Some respondents preferred not to be recorded, while others were interviewed in circumstances not conducive to recording (e.g., too much background noise or distractions, or respondent was engaged in another activity such as sled building or cooking during the interview). Researchers also found that transcribing interview tapes was far more time-consuming than the project budget allowed.

Key respondent interviews were supplemented by participantobservation work to the extent possible. In the upper Kobuk River area, researchers spent one week in September 2002 at fish camps of Shungnak elders and one day each in June 2002 and June 2003 documenting spring whitefish fishing and net sites. In Selawik, researchers visited fish camps for two days in June 2002 and three

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days each in June 2003 and September 2003. One day was spent participating in the under-ice whitefish fishery in Selawik in November 2002. In the Kotzebue area, researchers spent four days in September 2003 at *Anigaaq* (Aniyak) in Cape Krusenstern National Monument, the site of Kotzebue's major fall whitefish fishery. Researchers joined biologists Charlie Lean of the National Park Service and Randy Brown of the U.S. Fish and Wildlife Service during portions of the participant-observation work in Selawik and *Anigaaq*. Photographs taken during the field trips illustrate this final report. Because the project investigators all reside in Kotzebue, each also brought additional personal knowledge of and experience with regional fishing practices to this project, aside from that obtained during participant-observation activities. The research benefited substantially from this existing knowledge.

Topographical maps were used in both interviews and participant-observation activities to document key subsistence and habitat areas for whitefish. The investigation plan originally proposed to record key sites in the field using a Global Positioning System, and to then use this information to develop a Geographical Information System database. This did not work out as anticipated for these reasons: 1) researchers were able to visit only a handful of the key sites mentioned by respondents; 2) many sites described by respondents were easily located on U.S. Geological Survey maps; and 3) personnel changes at the Selawik National Wildlife Refuge made expertise in assembling GIS databases unavailable. As a result, mapped information was collected on standard topographical paper maps in the 1:250,000 and 1:63,360 scales. Some of this mapped information was collected during interviews, and some recorded by researchers while traveling by boat to fish camps and net sites.

Although mapped information was collected in each study community, the quantity and content of each varied. In Selawik, Noorvik, and Shungnak, mapped information focused on the location of fish camps and net sites. Some information was obtained on traditional locations of the harvest method known in Iñupiaq as *taluyaq* or *saputit* (fish weirs). In Kotzebue, mapped information depicted net sites at *Anigaaq* and other coastal harvest areas for whitefish. Mapped information for Noatak included several key lakes and sloughs providing both habitat and subsistence fishing areas for whitefish. Researchers were not successful in mapping whitefish spawning areas. Many respondents had little knowledge of these spawning areas, and those who did had generalized knowledge not readily transferable to lines on a map. Respondents also were generally unable to pinpoint critical habitat areas on a map, perhaps because whitefish are so widespread throughout the region's waterways.

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Reliably productive fishing sites, however, can be indicative of important habitat. Similarly, although familiar with specific locations of beaver dens and dams, respondents were generally unable to provide a meaningful overview of beaver activity on a map during the course of the interviews. This topic might be worth exploring at another time with other respondents, particularly hunters and trappers, in more narrowly focused interview sessions.

The maps presented in this report depict most of the place names mentioned in the text and summarize key portions of the geographical information collected during the interviews. Highly specific sites, such as gillnet locations, were too detailed to be included in these scales of maps. In many cases, the place names shown on the maps are those in common usage among respondents. These are often the proper Iñupiaq place names, rather than the English rendering of Iñupiaq words widely found on standard topographical maps of this region.

Although this project's methodology is simple and straightforward, the actual collection of traditional knowledge is in fact quite complex and challenging. This is especially true in a cross-cultural environment with elderly respondents most comfortable in their Native language, as is the case in northwest Alaska. For many Iñupiaq speakers, communicating in English with an interviewer is difficult. Respondents generally are unaccustomed to articulating their vast store of knowledge in a way that is precise, thorough, and easy for a researcher to follow. Most people simply do not think about the world and their experience in this way. The interviewer must often clarify, for instance, whether a respondent's statement applies to spring but not fall, or to all whitefish or only broad whitefish, or to the present or the past. Many questions simply do not have a clear-cut answer, despite scientists' desire for one. Subsistence fishermen's holistic view of the natural world makes it difficult to partition their knowledge into discrete topics, as befits a report. Each respondent tends to offer different bits of understanding and explanation, and the researcher must then assemble all these pieces into a coherent summary, often having to judge the quality of pieces of information based on the respondent's knowledge and experience. In addition, in any community there is considerable environmental and cultural knowledge that is assumed to be held by everyone. This knowledge is so ingrained that it often does not occur to respondents to mention it, and researchers can therefore inadvertently miss key pieces of information. For this reason, it is immensely valuable for researchers to have some personal familiarity with the setting, the resource, or the community to bridge this spoken information with the unspoken.

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Community	(2003)	Location	River and Environmental Features	Nearby Federal Public Lands
Kobuk	125	Upper Kobuk River	Medium current; gravel river bed; salmon and sheefish spawning areas; mixed forest and tundra	Gates of the Arctic National Park and Preserve
Kotzebue	3,076	Kotzebue Sound coast	Estuarine and marine waters; coastal lagoons; predominantly tundra	Cape Krusenstern National Monument
Noatak	469	Middle and lower Noatak River	Swift current; clear water; rocky river bed; salmon spawning areas; mixed forest and tundra	Noatak National Preserve
Noorvik	649	Kobuk River delta	Complex waterways; slow current; muddy river bed; salmon run; mixed forest and tundra	Selawik National Wildlife Refuge
Selawik	821	Selawik River delta	Complex waterways; slow current; tannic water; muddy river bed; no salmon run; predominantly tundra	Selawik National Wildlife Refuge
Shungnak	264	Upper Kobuk River	Medium current; gravel river bed; salmon and sheefish spawning areas; mixed forest and tundra	Gates of the Arctic National Park and Preserve

TABLE 2-2. CHARACTERISTICS OF STUDY COMMUNITIES.

Six communities were selected for study in this project: Kobuk, Kotzebue, Noatak, Noorvik, Selawik, and Shungnak. A primary criterion for selection was the community's proximity to federal public lands or to waters under federal subsistence management. A secondary criterion was for the community to be representative of one of the different natural environments in the Kotzebue Sound region. In the FIS-funded research, two study communities were selected in each of the two years of the project for a total of four communities. In the first year, Selawik and Noatak were study communities, and in the second year Noorvik and Kotzebue. An additional pair of communities, Shungnak and Kobuk, were study communities in the parallel project funded by the National Park Service. Together these communities represented the largest watersheds in the region-the Noatak, Kobuk (both delta and upriver areas), and Selawik-as well as an example of a coastal area (Kotzebue). These six communities were within or adjacent to one of the following federal public lands: Noatak National Preserve, Cape Krusenstern National Monument, Selawik National Wildlife Refuge, or Gates of Arctic National Park and Preserve. The study communities ranged in size from Kobuk with a population of 125 to the regional center of Kotzebue with a population of 3,076. Populations and characteristics of the study communities are listed in Table 2-2.

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Interview materials were organized by community and entered into a computerized, searchable format. Respondents' names were removed from the notes to provide a measure of anonymity. The investigation plan originally proposed to use AskSam software for the searchable format, but this was later changed to Adobe Acrobat software, which offered easier access to more people to the interview materials.

Existing literature on the biology, traditional knowledge, and subsistence uses of whitefish was reviewed throughout the course of the project. Where appropriate, information from these existing sources has been woven into the following narrative of project results to provide a fuller picture of the knowledge and use of whitefish in the Kotzebue Sound region.

3 Environment

Located astride the Arctic Circle in the northwest quadrant of mainland Alaska, the Kotzebue Sound region presents an interesting mix of landforms and waterways and their associated plant and animal life. The subarctic gives way to the arctic in this region. Northern spruce forests along the rivers and in the uplands intermingle with thickets of willow and alder and extensive tracts of tundra. The continent's boreal forest disappears completely in the northern and western portions of the region. Mountain ranges and hills are interspersed with treeless, pond-studded lowlands to provide topographical variety. Three large rivers-the Noatak, Kobuk, and Selawik-drain the region along with numerous smaller rivers and streams. These three rivers empty near Kotzebue, creating an extensive delta and estuary area with shoals, shifting mud flats, and grassy shallows etched by deeper channels. Along the coast to the north and south of Kotzebue, lagoon systems are a common feature. With the large volume of fresh water from nearby rivers, a true marine environment does not begin until several miles seaward from Kotzebue.

The deltas of the Kobuk and Selawik rivers are particularly complex waterways with multiple channels and countless sloughs and lake systems. The Selawik—primarily a river of the tundra—is the most tannic and meandering of the three major rivers, with a slow current and a mud river bed in all but its upper reaches. The Noatak River, in contrast, drains the mountainous Brooks Range and flows comparatively swift and clear. Except near its mouth, its river bottom is mostly rocky, and braided channels are common along its length. The Kobuk River is between these other two—swifter and clearer than the Selawik, but slower and darker than the Noatak. The slow, meandering water and mud river bed of the lower Kobuk yield to a quickening flow and gravel bottom in its middle and upper reaches.

These diverse river and coastal conditions in the Kotzebue Sound region influence whitefish distribution, seasonal movements, and subsistence harvest techniques and timing. Though similar in many ways, each study community occupies a somewhat different







Figure 3-1. The upper Kobuk River, September 2002. Several Shungnak families maintain fall fish camps on the upper Kobuk River, about 40 river miles above Shungnak. At left is the view looking northeast from Vera Douglas' camp. The Kobuk is fed from the north by swift, clear mountain streams draining the Brooks Range, and from the south by slow, tannic streams draining lowland lake systems. Above, a homemade barrel stove in Vera's wall tent at her fish camp.



Susan Georgette

Figure 3-2. An aerial view of a family camp along the Kotzebue Sound coast between Cape Krusenstern and Anigaaq. The ocean is in the foreground and the waterways of the Krusenstern Lagoon system are in the background. Despite the whale bones, above, large whales are rare here. Bearded seals, smaller seals, waterfowl – and whitefish – are seasonally abundant.





James Magdanz







Susan Georgette (2)

Figure 3-3. Pauline Ramoth's fish camp at Kuvraqtuġvigruaq along the Selawik River near the village of Selawik, June 2003. The nets set at the camp are catching whitefish and pike to make paniqtuq (dried fish), above. Drying in the background are small sheefish, or mayuayuk. Spring is the preferred season for drying whitefish in Selawik. The weather is cool and dry, and flies are not yet a problem.

Environment



Figure 3-4. The Woods' family fish camp at Qalugriivik on the upper Kobuk River, with the Brooks Range in the background. September 2002. environment, leading to each having its own unique pattern of resource use. A basic knowledge of these environmental differences provides an important context for understanding the natural history and subsistence uses of whitefish.
4 Natural History

The following narrative, divided by topic, summarizes the traditional knowledge of whitefish gathered during key respondent interviews conducted for this project. To add to the depth and scope of the report, information from existing sources is also presented in places. The narrative begins with a brief comparison of the Iñupiaq and Linnaean taxonomic systems for whitefish. Following this is a discussion of the natural history of whitefish as understood by Iñupiaq fishermen in the study communities. This covers whitefish distribution, seasonal movements, feeding habits, spawning, and health and abundance, and includes summaries by species. The next chapter in the narrative discusses subsistence harvest and use of whitefish, with information presented by community. Harvest estimates of whitefish from secondary sources are also provided. Readers should note that this report only covers information from the study communities-Kobuk, Kotzebue, Noatak, Noorvik, Selawik, and Shungnak-representing the physical geography of northern Kotzebue Sound, the Selawik River delta, the Kobuk River delta, the upper Kobuk River, and the lower and middle Noatak River. Other important and distinct areas in the region, such as the northern Seward Peninsula and the Chukchi Sea coast north of Kotzebue Sound, were not part of this study.

Iñupiaq Taxonomy of Whitefish

One of the goals of this research was to assemble a complete and precise Iñupiaq taxonomy of whitefish in the Kotzebue Sound region. This topic has proved elusive to researchers for many years as evidenced by the discrepancies found in existing literature. For example, in Anderson and Anderson (1977) the Iñupiaq names listed for broad and humpback whitefish are incorrectly reversed, and the identification of *ikkuiyiq* as Bering cisco is mistaken. Burch (1998) similarly describes the place name *Iquyiq* on the lower Fish River near Selawik as meaning "Bering cisco," but research in this current project revealed that this word in fact refers to humpback whitefish.







Figure 4-1. Three humpback whitefish. This is the whitefish species caught in greatest abundance in most of the region's villages, and is the preferred species for making paniqtuq (dried fish), a staple food in the Kotzebue Sound region.



James Magdanz

Figure 4-2. A humpback whitefish (top) and a round whitefish (bottom) caught in the same set of a seine on the upper Kobuk River in September 2002. Note the orange color in the lower fins (pectoral, pelvic, and anal) on the round whitefish, a distinctive feature of this species in the fall.

Much of the confusion surrounding the identification and naming of whitefish is perhaps rooted in the absence of a shared vocabulary for discussing them. While Native fishermen nearly universally know whitefish only by their Iñupiag names, scientists and researchers typically know them only by their common English or scientific names. Furthermore, differentiating the whitefish species in any language is difficult for the casual observer because of the fishes' many similarities, sometimes subtle differences, and tendency to be found mixed together. In this project, the use of photographs of whitefish species during the interviews helped immensely in identification, but still did not always resolve unequivocally the question of which scientific name corresponded to the Iñupiaq-named whitefish under discussion. This was especially true with the ciscos. A fish in hand was the best way to obtain a definitive correlation between the two naming systems. This took place on several occasions during the course of the research, but some questions nevertheless remained, especially in Selawik.

Although this project did not ultimately sort out every detail of Iñupiaq whitefish taxonomy, it nevertheless clarified many aspects of the indigenous naming system for these fish. Depending on their community of residence, Kotzebue Sound residents commonly recognized four to five species of whitefish, but sometimes as many as seven. In all the study communities except Selawik, Iñupiaq taxonomy of whitefish appeared to be largely congruent with the Linnaean taxonomic system. Iñupiaq terms for the whitefish species, however, varied among communities and even within communities,

indicative of the dialectal differences in the region. This made it challenging at times to determine which names denoted a different fish, and which were simply different names for the same fish. Some names varied slightly (*qalupiaq* vs. *iqalupiaq*), while others were entirely different (*qalusraaq* vs. *aquutituuq*).

In the Kobuk River communities, substantial uniformity existed among respondents in the names offered for each species; nearly everyone, for instance, called broad whitefish *qausriluk*, humpback whitefish *qaalģiq*, and so on. In Noatak and Kotzebue more variability was found among respondents in the names used for whitefish. For example, Noatak and Kotzebue respondents used both *qausiluk* and *sigguilaq* to mean broad whitefish, and all respondents asserted that these were different names for the same fish. One elder in Noatak used *savaigutniq* as the Iñupiaq word for round whitefish, while other respondents used the term *quptik*, commonly heard in Kobuk River villages. *Savaigutniq* is also the term for round whitefish used by Uhl and Uhl (1979) in their discussion of subsistence activities in Noatak in the 1970s.

Selawik presented a different case, displaying the most complex whitefish taxonomy of the study villages. Researchers surmised that Selawik had developed a particularly discriminating approach to whitefish, perhaps because whitefish are so central to the community's subsistence activities. As far as researchers could discern, Selawik residents recognize two species, *ikkuiyiq* and *qaalģiq*, where biologists recognize one, humpback whitefish. *Ikkuiyiq*, which translates as "Fish River fish," are considered by Selawik residents to be the humpback whitefish found in the Fish River north of Selawik as well as in the upper Selawik River, *Sinjaģruk* (Singauruk Creek), and other places. *Qaalģiq*, a second type of humpback whitefish, has a different shape and taste than *ikkuiyiq* and is not particular to certain locations, being found anywhere in the Selawik area. Selawik respondents affirmed that these were two different kinds of fish, and not two names for the same fish.

Similarly, Selawik residents discriminated among what biologists know as least cisco, recognizing two types of fish as distinct from each other: *anuutituuq* and *qalutchiaq*. One elder described *anuutituuq* as a "stouter fish" with a differently shaped head than *qalutchiaq*.

Finally, Selawik residents used three terms—*qalupiaq*, *qausriluk*, and *siyyuilaq*—for what biologists simply recognize as broad whitefish. The distinguishing features of these three types of whitefish were not clear to researchers, but at least the latter two—and possibly all three—were considered by Selawik respondents to be separate types of fish. One of the researchers watched as a Selawik



Susan Georgette

Figure 4-3. Broad whitefish (top), humpback whitefish (middle) and least cisco (bottom), Selawik River, June 2003. Note the fleshy, "big-nose" look of the broad whitefish and the "pinched head" look of the humpback whitefish. Another distinctive feature is their egg color: broad whitefish have pale eggs, humpback whitefish have light orange eggs, and least cisco typically have bright orange eggs. elder cut fish, pointing out the *qalupiaq* and the *siyyuilaq* as she worked, but the distinctions were too subtle for the researcher to grasp. The taxonomy of whitefish as understood by Selawik residents is a topic meriting additional exploration by skilled bilingual researchers in association with biologists.

The Iñupiaq word *qalupiaq* (or *iqalupiaq* in Noatak and Kotzebue) is a generic term for any kind of whitefish, used to distinguish them, for example, from other kinds of fish such as northern pike or char. In some villages the term *qalupiaq* (or *iqalupiaq*) was also used by respondents to mean the predominant local whitefish species, which depending on the village might be a broad whitefish (Selawik) or a humpback whitefish (Kotzebue and Noatak). Key respondents in the Kobuk River villages used English similarly, at times employing the term *whitefish* to mean any kind of whitefish and at other times to mean humpback whitefish, the predominant species. *Qalupiaq* literally translates as "real fish," an indication of the significance of whitefish in the region.

Additional Iñupiaq words exist to describe whitefish of a par-

		Iñupiaq Names ¹				
English Names	Scientific Name	Selawik	Noorvik	Shungnak and Kobuk	Noatak	Kotzebue
broad whitefish short-nosed whitefish	Coregonus nasus	siyyuiļaq	qausriļuk	qausriļuk	sigguiļaq qausiļuk	sigguiļaq qausiļuk
		qausriļuk				
		qalupiaq				
humpback whitefish needle-nosed whitefish sharp-nosed whitefish	Coregonus pidschian	qaalġiq	qaalġiq	qaalġiq	qaalġiq iqalupiaq iqalutchiaq	qaalģiq iqalupiaq iqalutchiaq
		ikkuiyiq				
least cisco	Coregonus sardinella	aŋuutituuq	qalusraaq	qalusraaq	iqalusaaq	iqalusaaq
		qalutchiaq				
Bering cisco	Coregonus laurettae	2	tipuk	2	tipuk	tipuk
round whitefish	Prosopium cylindraceum	quptik	quptik	quptik	savaigutniq quptik	2
whitefish of any kind		qalupiaq	qalupiaq	qalupiaq	iqalupiaq iqalutchiaq	iqalupiaq

TABLE 4-1. ENGLISH, SCIENTIFIC, AND IÑUPIAQ NAMES FOR WHITEFISH SPECIES.

¹ Where more than one name is in the same box, these are different names for the same fish. Where each name is in its own box, these are considered different fish.

² This fish was not familiar enough to these communities for residents to be confident about its name.

ticular size. For example, *tipuaksraq* is a small *tipuk* or Bering cisco; *siyyuilauraq* is a small *siyyuilaq* or broad whitefish; and *qaaġliaġruk* is a large *qaalġiq* or humpback whitefish. An observation of whitefish hybrids was made by one respondent in Shungnak who noted that "sometimes whitefish seem like they're half-and-half, like they are different kinds mixed together." A Kotzebue respondent described catching a hybrid sheefish-Bering cisco on the lower Noatak River and a hybrid sheefish-humpback whitefish on Kobuk Lake. Scientific literature reports such hybridization to be common among whitefishes with studies available for almost all pairs of whitefish crosses (Mecklenburg et al. 2002).

Table 4-1 compares the English, scientific, and Iñupiaq terms for whitefish species by community. Assistance with the Iñupiaq terminology and spelling was provided by Ruth Sampson of the Northwest Arctic Borough School District, Hannah Loon of NANA Regional Corporation, and Barbara Armstrong of the U.S. Fish and Wildlife Service. This is not intended to be a definitive linguistic presentation of Iñupiaq terminology for whitefish, but a summary of the terms offered by respondents during the interviews.

Species Summaries

The whitefish species covered by this research have much in common, yet each is also distinct in its own way. The different species are typically found mixed together in varying proportions depending on the location and season, and are often harvested and used similarly. The following section summarizes the distinctive characteristics of each whitefish species, their Iñupiaq names, and their correlation to western scientific taxonomy. To be more accessible to fishery managers and scientists, this section has been organized according to the scientific classification system, although it would make more sense in a TEK study like this to organize the material according to an Iñupiaq view of fish. Additional information pertaining to whitefish in general is presented in following sections. Excellent detailed information on the cutting, processing, cooking, and storing methods for whitefish is available in Jones (2003).

Broad Whitefish Coregonus nasus

- Qausriļuk, qausiļuk
- Siyyuilaq, sigguilaq
- Qalupiaq

The broad whitefish is the biggest whitefish (other than sheefish) and one of the two key whitefish species in the region for subsistence fishermen. It is a fat, rich fish, and for this reason is a preferred fish in many communities. The high fat content, however, makes these fish difficult to dry without spoiling, especially in the spring, and fishermen therefore prefer not to catch them for *paniqtuq* (dried fish). One of their distinguishing characteristics is their very thick scales, making them more difficult to scale than other whitefish species.

The broad whitefish is known in the region by several Iñupiaq names, the most common of which is *qausriluk* or, in the coastal dialect, *qausiluk*. In Kotzebue, Noatak, and Selawik, broad whitefish are also called *sigguilaq* (coastal) or *siyyuilaq* (Selawik), which literally translates as "without a beak or snout." A handful of respondents occasionally referred to broad whitefish by the English name "short-nosed whitefish," but for the most part northwest Alaska residents nearly always used Iñupiaq words to differentiate the whitefish species. Rarely were respondents familiar with the name "broad whitefish."

In Kotzebue and Noatak, respondents considered *qausiluk* and *sigguilaq* to be two different names for the same fish. In Selawik, respondents regarded *qausriluk* and *siyyuilaq* as two different types of fish. In addition, Selawik residents possibly recognized a third type of broad whitefish called *qalupiaq*. The distinctions between each of these three types of broad whitefish in Selawik were subtle and not entirely clear to researchers, but can best be summarized from the interviews as follows:

- *Qalupiaq*. This is one of the most common whitefish around Selawik, available year-round. It is a very fat, rich fish and preferred by many people. One elder said *qalupiaq* are "the ones around in the lakes," in contrast to the broad whitefish in the Selawik River. Another said that the stomachs of *qalupiaq* were "full of things," an indication that these whitefish are feeding. They are easier to scale than the larger *qausriluk*. *Qalupiaq* literally means "real fish" in Iñupiaq and is also used as a generic term for whitefish.
- *Qausriluk*. This was described as the biggest whitefish. It has a reputation for being difficult to scale and for being "rough along the back." One resident said *qausriluk* are "the ones coming from Selawik River, like Kobuk River fish," and another said they are caught only in the fall. *Qausriluk* were described by one Selawik elder as "a big *qalupiaq*." They are reportedly long and skinny at times and have less fat than *qalupiaq* because they are a "clearwater" fish. Some Selawik residents consider the meat of *qausriluk* to be tough, and therefore prefer to eat *qalupiaq*.
- *Siyyuilaq*. Described as something between a humpback and a broad whitefish, *siyyuilaq* were reported by Selawik respondents to have shorter and rounder lips than *qalupiaq*. They are also smaller in size and taste differently when eaten as *quaq* (frozen fish, often aged). *Siyyuilaq* are found throughout the Selawik area, especially in the fall but also at other times of year.

Respondents in Selawik also spoke often of *Tuqtumaaġruk* fish, a variety of *qalupiaq* found in the Tuklomarak River area south of the village. These fish are particularly prized for their tastiness as *quaq* (frozen fish, often aged). They are sweet and firm and the fat is "just right." Residents described them as smaller than *qalupiaq* with lips that are rounded in front. One person described them as





Susan Georgette (2)

Figure 4-4. James Ramoth (right) chops a net pole out of the Selawik River ice, November 2002. Gillnets set under the ice on the Selawik River after freeze-up catch large numbers of fish, mostly broad whitefish along wtih smaller numbers of humpback whitefish, sheefish, and northern pike. The day's catch is wrapped in a tarp and transported back to the village in a snowmachine sled (above).



"not really adult fish." Another said:

The best fish are over at *Tuqłumaaġruk* [Tuklomarak Lake]. They are small *qalupiaq*—real good when you eat them frozen. They stop growing when they're small. Even though you go back next year, they never grow.

Broad whitefish are apparently more abundant along the Kobuk and Selawik rivers than in the Noatak and Kotzebue areas. Respondents in Noatak and Kotzebue frequently described broad whitefish



as "Kobuk River fish." One Noatak elder, when asked if he catches *qausiluk* (broad whitefish), responded:

Hardly. We get them hardly. Up at Kelly, close to Kelly area, we get those once in awhile. Not too many. Maybe two at a time when we were seining. Hardly any. Lot of them over at *Sivu*, Noorvik, Kiana. That's their river. . . . Our river is too swift maybe. This is ours right here [pointing at picture of humpback whitefish]. These are good fish, too.

Several Noatak fishermen mentioned that broad whitefish come out of *Narvaġruk* (Lake Narvakrak), a large lake east of the Kugururok River mouth, in the fall. One Noatak resident said:

In fall, big *qausiluk* come out of a big lake near *Kuugruaq* [Kugururok River]. You can tell when they come out. They are real dark and big, but they mix in with other whitefish. The lake is north of the [Noatak] river. My brother sets a net each year to catch these.

Another Noatak elder described:

On the left side of the canyons there is a big lake. Right inside *Kuugruaq* [Kugururok River] not too far from the mouth [is the creek that drains this lake]. I never see it but old man say when it's not windy in August and September it's just like rain falling when the whitefish start splashing in there. Both *qausiluk* [broad whitefish] and *iqalutchiaq* [humpback whitefish]. In springtime they go up there. In June and July. They spend the summer there.

Other Noatak fishermen said that broad whitefish are also found on the Noatak flats in the *Sivisuuq* (Sevisok) area in the fall, particularly in certain smaller creeks. Uhl and Uhl's subsistence report (1979) on Noatak describes broad whitefish as primarily inhabiting the lower Noatak flats area, and seldom being caught above Noatak village.

The local perspective of Kotzebue fishermen is that broad whitefish are primarily a fish of freshwater lakes. Kotzebue respondents who fish in the *Anigaaq* (Aniyak) area near Cape Krusenstern reported that broad whitefish were not common there. The following observations of broad whitefish were provided by three different elders:

We don't have those lots. They travel, too, all right, once in a great while by groups. They got them this summer . . . behind Sisualik, across there. That's where they get those kind. *Qausiluk* or *sigguilaq*. Someplace back there they get those. Somehow they travel up there and they start getting them. Two days, maybe, they pass by.

We get only a few *sigguilaq* [broad whitefish], even less than *tipuk* [Bering cisco]. We don't get ones that look like they are going to spawn. They are not real fat and not very big either, compared to the ones on the Kobuk River. They might just be swimming around and eating at *Anigaaq*.

We occasionally catch *qausiluk*, although maybe rarely would be a better word.

One Kotzebue respondent described the sloughs and mud flats behind Sisualik as a brooding place for "half-grown" broad white-



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Figure 4-5. James Ramoth, Sunii Jackson, and Aaron Andrews take a break after checking an under-ice gillnet set in the Selawik River near the village of Selawik, November 2002. The day's catch is in the foreground.



James Magdanz

Figure 4-6. Tub of mostly humpback whitefish (qaalġiq), upper Kobuk River, September 2002. The fish were cut and hung to dry as amatchiaq (dried whitefish with roe intact), a delicacy in many villages. fish. This area, though not highly productive for whitefish, is locally known for its broad whitefish that are not yet full adults.

In the Kobuk River and Selawik areas, broad whitefish are caught with a variety of other fish soon after spring break-up in gillnets set at the mouths of small creeks draining lake systems. In the upper Kobuk, they are caught in small numbers in seines in summer and fall, mixed in with other whitefish, primarily humpback whitefish. However, the primary fishery for broad whitefish along the Kobuk River and in Selawik takes place with nets set under the river ice in late October and November. In Shungnak, a key under-ice fishing site for broad whitefish is at *Katyaak*, about 12 river miles below the village. In Selawik, most under-ice fishing occurs near the upriver edge of town. Broad whitefish are the last whitefish to spawn in the fall, accounting for their abundance in the under-ice fisheries. One experienced under-ice fisherman in Shungnak believed that broad whitefish typically spawn in the local area around November 6 or 7.

In Noatak, one elder believed that the late fall timing of the broad whitefish movements explained why Noatak caught few of these fish. Because of the swift current, under-ice fishing is not as common in Noatak as in the Kobuk and Selawik river villages. This elder said:

We don't really get too many *qausiluk* [broad whitefish] because they come out of the lakes later when it starts getting slushy. They have big eggs, lots of eggs. They come down late, so we don't get them much. The current is strong here, but you can fish under the ice if you go further downriver. Kiana and Noorvik get these kinds [broad whitefish], and we sometimes get fish from them.

Broad whitefish are most commonly eaten with seal oil as *quaq* (frozen fish, often aged). In summer and fall they are typically halfdried then stored in a freezer to cook later. They are also freshly roasted, baked, or boiled. Occasionally broad whitefish are cut for *paniqtuq* (dried fish), but because they are fat and spoil easily they are dried far less frequently than humpback whitefish. A respondent in Selawik explained:

When you dry *qalupiaq* [broad whitefish] in the spring, they are real fat. When you dry them, they always get yellow because they have too much oil. The fish have rich food up there to eat. Their stomach is always full of oil.

Humpback Whitefish Coregonus pidschian

- Qaalģiq
- Ikkuiyiq
- Iqalupiaq, iqalutchiaq

The humpback whitefish is the second of the two primary whitefish species used by subsistence fishermen in the Kotzebue Sound region. It is the whitefish species caught in greatest abundance in most of the region's villages, and is the preferred species for *paniqtuq* (dried fish), a staple of *niqipiaq* (Iñupiaq Native food). It is a medium-sized fish, generally smaller than broad whitefish and larger than least cisco.

Scientists continue to debate whether the three Alaskan species in the humpback whitefish complex—lake whitefish *Coregonus clupeaformis*, Alaska whitefish *Coregonus nelsonii*, and humpback whitefish *Coregonus pidschian*—should be recognized as one species or three. Mecklenburg et al. (2002) report that the only distinguishable feature among the three is their modal gill raker counts, and Brown (2003a) asserts that definitive identification of individual



Figure 4-7. Humpback whitefish, Kobuk River, September 2002. Note the similar head shape in three fish of different body sizes.

fish to one of the three species is not possible. By convention, most contemporary fishery biologists in Alaska refer to all humpback whitefish as *C. pidschian*.

Like broad whitefish, the humpback whitefish in the Northwest Arctic region is primarily known by its Iñupiaq names. In the Kobuk River villages and Kotzebue, it is called *qaalģiq*. In Noatak, it is called *qaalģiq* by some respondents and *iqalupiaq* or *iqalutchiaq* by others. These latter two words—the coastal dialect equivalents of *qalupiaq*—are generic terms for whitefish, but are used in Noatak to denote humpback whitefish as well. A few respondents occasionally referred to humpback whitefish by the English name "sharp-nosed" or "needle-nosed" whitefish, or simply as "whitefish."

As with broad whitefish, Selawik had the most complex taxonomy of humpback whitefish among the study communities. Respondents in Selawik described two types of humpback whitefish found in the local area: *ikkuiyiq* and *qaalģiq*. The distinguishing features of each were difficult for researchers to document, and is a topic deserving further exploration by skilled bilingual researchers. The following summaries of these two types of humpback whitefish were assembled from interviews with Selawik respondents:

• Ikkuiyiq. This is a smaller whitefish than qalupiaq (broad

whitefish). It is also smaller and has a more pointed nose than *qaalģiq. Ikkuiyiq* are found primarily northeast of Selawik in the Fish River as well as in *Siŋiaġruk* (Singauruk River) and the upper Selawik River. The Iñupiaq place name for Fish River is *Ikkuiyiq*, and hence the name of these fish translates as "Fish River fish." *Ikkuiyiq* is the least oily of the whitefish and therefore particularly good for drying. Once dried, *ikkuiyiq* can be stored without a freezer, unlike the fatter broad whitefish which spoils or becomes strong in taste if not kept cold. One respondent described *ikkuiyiq* as "mostly a clearwater fish," and another said they "come from the rivers" rather than being found in the lakes. They have roe in the fall and "clean" stomachs, with no food or grit in them. *Ikkuiyiq* are primarily caught in the fall. "We hardly get them in the springtime," one elder said.

• *Qaalģiq*. This fish is bigger and fatter than *ikkuiyiq*, but smaller than *qalupiaq* (broad whitefish). Like *ikkuiyiq*, it is considered easy to dry. It is found throughout the Selawik area. One elder said, "*Qaalģiq* go to the lakes. You can catch them all around Selawik. They have a different shape and taste than *ikkuiyiq*." Another fisherman described *qaalģiq* as having lumpy skin. They are caught in gillnets in spring and fall and also in nets set under the ice.

In the Northwest Arctic region, the humpback whitefish is the staple whitefish that is cut and dried for *paniqtuq* (dried fish). Both *siraatchiaq* (dried whitefish without roe) and *amatchiaq* (dried whitefish with roe) are produced primarily from humpback whitefish, particularly along the Kobuk River and in Selawik. (In Selawik, the term used for "dried whitefish with roe" is *aanaalik* rather than *amatchiaq*. In other villages in the region, *aanaalik* means "dried salmon with roe.") Humpback whitefish are considered easy to dry and to scale. According to upper Kobuk residents, humpback whitefish spawn in the local area at the same time as or shortly after sheefish, usually in late September or early October.

In Noatak and Kotzebue, humpback whitefish is the predominant whitefish species caught by subsistence fishermen. It is also the primary species caught along the Kobuk River, although supplemented by the much-desired *qausriluk* (broad whitefish). In Selawik broad whitefish is the whitefish species caught in greatest number, with humpback whitefish contributing secondarily to the harvest.

Throughout much of the region, humpback whitefish are typically caught in gillnets after break-up in May or June. Beginning in



July, they are seined from river eddies along the Kobuk and Noatak rivers, but usually in relatively small quantities because the weather is too warm for drying fish. The primary fishing season for humpback whitefish is in the fall when they are caught in seines, gillnets, and *qargisat* or ditches, an unusual harvest technique used in the lagoon systems near Kotzebue (see Kotzebue section in chapter 5 for more detail). Depending on the season and the preference of the fisherman, humpback whitefish are typically cut and hung to dry or stored in sacks, elevated boxes, or grass-lined pits to age and freeze for *quaq* (fish eaten frozen).

Least Cisco Coregonus sardinella

- Qalusraaq
- Iqalusaaq
- Qalutchiaq
- Aŋuutituuq

The least cisco is the smallest whitefish common throughout the region. One of its distinguishing physical characteristics is that its lower jaw extends slightly beyond its upper jaw. It is also often described as having a big eye. In sheer number, it may well be the most abundant whitefish in the region, but because of its small size it is not as much a focus of fishing as the larger humpback and broad whitefish. Many people, however, consider the eggs of the least cisco a delectable treat in the fall, and fishermen in all the study communities occasionally burst open the bellies of these fish immediately after catching them in the fall to savor eating the raw, fresh eggs. The eyes of least cisco are similarly savored by some elders.

Like the other whitefish species, the least cisco is almost exclusively known in the region by its Iñupiaq names: *qalusraaq* in the Kobuk River communities and *iqalusaaq* in the coastal dialect of Noatak and Kotzebue. In Selawik, residents recognize two types of least cisco: *qalutchiaq* and *anuutituuq*. *Anuutituuq* was described as a "stouter fish" with a differently shaped head than *qalutchiaq*. *Qalutchiaq* were particularly abundant near the stream system known as *Kuutchaappaat* on the east side of Inland Lake. Other differences likely exist as well, meriting further investigation by skilled bilingual researchers.

In general, least cisco are fairly common throughout the region, although not particularly plentiful in subsistence gillnet catches because their small size allows them to pass through nets set for

larger fish. Although researchers were not able to document the precise range of least cisco region-wide, interviews in Shungnak and Kobuk revealed new information on its range in the upper Kobuk River. According to upper Kobuk respondents, the upriver limit of least cisco generally lies somewhere between Ambler and Shungnak, a more limited range than that of other locally available whitefish species. From time to time upper Kobuk fishermen catch least cisco in large numbers as far upriver as the *Qala* area, but typically they are caught in only small numbers in areas upriver from Shungnak. In general least cisco are neither as abundant nor as desired as *qausriluk* (broad whitefish) and *qaalgiq* (humpback whitefish) in the Shungnak and Kobuk area.

In their research on traditional knowledge of fish in the Koyukuk River area, Andersen, Brown, Walker, and Elkin (2004) report that the Iñupiaq term used in Alatna for least cisco—*saavaayiq*—was adapted from the Koyukon Athabascan term for least cisco—*tsaabaaya*—because the least cisco was not present in the upper Kobuk region from where the Iñupiat relocated. At first glance, this information seems to contradict the findings of the current project in which Shungnak and Kobuk residents were clearly familiar with this fish. However, with the upriver range of least cisco identified by respondents as ending a short ways beyond Kobuk village, the Iñupiat in Alatna might well not have encountered this fish had they moved into the Koyukuk from farther up the Kobuk River.

In areas downriver from Shungnak, particularly near Ambler, least cisco can be caught in large numbers in fall with a smallmeshed (½-inch) seine net, known in Iñupiaq as *qarġun*. Seining with these small-meshed nets is difficult work because numerous small fish of all kinds are caught, making it tough to pull in the net. In addition, processing the catch takes considerable time. These specialized nets were reportedly more common in Ambler than in Shungnak and Kobuk. In Kobuk one respondent said, "We don't have those kinds of nets for *qalusraaq* anymore. They just go through the nets we use now." The continued use of these nets in Ambler might be associated with the greater abundance of least cisco in this area.

Upper Kobuk respondents said that least cisco spawn in the local area at the same time as or shortly after humpback whitefish and sheefish, usually in late September. "They are always fat in September," one Shungnak elder said. One of the distinctive characteristics of least cisco is that their eggs are different colors, with some fish having orange eggs and others yellow, pink, or white eggs.

Least cisco are available in Noorvik, but because of their small size they are caught in seines more than in gillnets. Noorvik respon-





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Figure 4-8. Least cisco, Selawik, September 2003. Note the large eye and the lower jaw extending slightly beyond the upper jaw. (Measuring stick in centimeters) dents said that few people continue to seine in contemporary times, in part because the decline in dog teams has reduced the need for fish. Large least cisco are occasionally netted in Noorvik in spring. Although caught in small numbers, least cisco are nevertheless considered tasty. One Noorvik fisherman said:

We get *qalusraaq* [least cisco] mixed in with other whitefish, but there are not that many, not like *qaalgiq* [humpback whitefish] and *qausriluk* [broad whitefish]. *Qalusraaq* make real good *quaq* [frozen fish]. When we seine, we used to bust them open and eat their eggs.

Selawik residents frequently described least cisco as a small whitefish with lots of orange or pink eggs. In this area it is mostly caught in the fall, beginning in August, and seldom in the spring. It often runs with *ikkuiyiq* (humpback whitefish) in the Fish River. One respondent said least cisco look "like herring, but are more broad." Another elder said that although these fish are small "you don't need a small net to catch them. They are wide around the middle and can get caught in the net."

Along the coast, least cisco are one of the two whitefish species—along with humpback whitefish—commonly found in the coastal lagoons, particularly *Anigaaq* and *Akulaaq* northwest of Kotzebue. Kotzebue fishermen who want to catch least cisco typically use a small-mesh gillnet, most commonly in the 3-inch range. Least cisco are prized by some fishermen for their good flavor and tasty eggs. One Kotzebue elder said:

We get *iqalusaaq* [least cisco] but they are small and we mostly cook them for dog food. We like to pop them open and eat their eggs in the fall. In summer, high water brings them into the lakes and lagoons along the coast. When you *sapi* it [make a weir] later, you can get lots of them.

Another Kotzebue elder who fishes in the Anigaaq area said:

Iqalusaaq [least cisco] is one of the favorites of a whole lot of people because of the good taste and the size of its roe, its eggs. In all of these lagoons, it is one of the first that's available. As far as I know in any of these lagoons, if you scratch a short ditch into it in September, any time in September, even early September, why, you'll have some *iqalusaaq* there. They'll be the easiest for you to get. They are relatively small and relatively unsophisticated, I'd say. They go out easily, and, again, they are a favorite. They vary from year to year, but there can be a real lot in some years. And they can be scarce in some years.

In Selawik, respondents considered least cisco (*aŋuutituuq* and *qalutchiaq*) easy to scale and to dry and good to eat as *paniqtuq* (dried fish), but in other communities least cisco are not routinely cut and dried because of their small size. Larger ones, especially with eggs, are often eaten as *quaq* (frozen fish, often aged) and smaller ones used for dog food. "We never cook them," one Selawik woman said. In Noatak and Noorvik, elders said that in the past people caught large amounts of least cisco for dog food, but these fish are rarely used today. One Noatak elder said:

A long time ago when I was a boy we used to get these kinds [least cisco]. Lots. But not now. We used to get lots of these for dogs. What we never eat we used for dog food back then. You can net them in falltime. Right now we don't want these kinds [of fish]. We put them back.

One Noorvik woman said least cisco are good for mudshark (burbot) bait. Some respondents said least cisco often have small worms in the meat and are generally not a preferred fish.

Bering Cisco Coregonus laurettae

• Tipuk

The Bering cisco has a limited range in the Northwest Arctic region. For the most part this cisco was familiar only to residents of coastal areas, namely Kotzebue and Noatak in this study. (Although Noatak is located inland, its residents typically summer along the coast north of Kotzebue.) Selawik and Noorvik residents had a limited familiarity with this fish, often describing it as a "saltwater" fish, while upper Kobuk residents were generally not familiar with it at all. The Bering cisco is nearly exclusively known in the region by its Iñupiaq name, *tipuk*.

One elder described Bering cisco as the "real fat round ones," an apt description for this richest and most oily whitefish. One of its distinguishing characteristics is the girth of its body, making



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Figure 4-9. Bering cisco (tipuk), Cape Krusenstern area, September 2003. Some scales were lost when the fish was removed from a gillnet. Bering cisco are a coastal fish, known for their richness and high oil content. They are relatively uncommon in the Kotzebue Sound region. it very round in cross-section in front of the dorsal fin. Its upper and lower lips are about equal in length, in contrast to least cisco whose lower lip extends beyond the upper, and broad and humpback whitefish whose upper lip overhangs the lower. According to respondents, Bering cisco are found along the shores and in the coastal lagoons near Kotzebue and in at least portions of Kobuk Lake (Hotham Inlet). They are rarely found in the rivers or delta areas. One Kotzebue elder said:

Tipuk [Bering cisco] are really on the coast, coast area, most of the [Kotzebue] Sound area, ocean. Even in Deering they travel in the ocean. All over they travel, those *tipuk*. On ocean side. They bunch sometimes when they travel. They're good for salted fish, too. Yeah, my brother used to wait for those *tipuk* to come around, and he'd set a net and make salted fish.

Another Kotzebue elder described his knowledge of Bering cisco in the Baldwin Peninsula and Kobuk Lake area:

Tipuk [Bering cisco] are a clean fish with no infestations. When we used to spend the spring at Riley Wreck, we used to get them in the spring. They come along the beach with the trout. They go up inside Kobuk Lake past Fish Creek. In the springtime you can get them all along the coast. . . . We get them in the fall at Fish Creek [on the north side of Kobuk Lake], but not as much as in the spring. We get them mixed with other types of whitefish. *Tipuk* are mostly an ocean beach fish. I have no idea when or where they spawn. My mom used to fish for them and salt them when we stayed at Riley Wreck. So delicious! We would soak them in water and fry them in the winter.

Among the coastal lagoons, *Qiliqmiaq* (Kiligmak) at the outlet of *Qutliq* (Kotlik Lagoon) north of Cape Krusenstern was often mentioned as a particularly good site for Bering cisco. One Noatak elder said: That's what I was talking about—fat, fat fish. Down at *Qiliqmiaq* [Kiligmak] and then this side of *Qiliqmiaq*, these *tipuk* [Bering cisco] are down there. Down in that area. I know one old man from Rabbit Creek, he used to under-ice fish down at *Qiliqmiaq*. Boy, he used to bring my dad this kind [of fish]. Fat, real fat! They're different than that [humpback] whitefish.

A Kotzebue respondent said:

Tipuk [Bering cisco] is what we get further down at *Qiliqmiaq*. Mostly *tipuk* at *Qiliqmiaq*. When the mouth is closed, we catch them in the lagoon with a net.

Bering cisco are also found in the lagoons at *Anigaaq* and *Akulaaq*, but not in great abundance. One respondent described them as "a little wilder and a little rarer" at *Anigaaq* than humpback whitefish. The following observations were offered by two Kotzebue fishermen:

Tipuk [Bering cisco] are mixed in with the other whitefish. We never get a lot of them. We get very few. We don't get ones that look like they are going to spawn.

We like those *tipuk*, all right, but there's few. When it starts getting cold, they start coming down. . . . Early spring they travel, those *tipuk*. Through the ocean side. And they come inside the outlet [at *Anigaaq*].

One Kotzebue respondent described a late fall run of Bering cisco from west to east along the coast near Sisualik. This takes place annually, usually around October 1, at about the same time as saffron cod's fall movement into nearshore waters. The size of this Bering cisco run varies from year to year. These are the last whitefish to pass by Sisualik before winter sets in.

Small Bering cisco, called *tipuaksraq* in Iñupiaq, were once commonly found at *Akulaaq*, a small lagoon between Sisualik and Cape Krusenstern. Today this area is rarely fished due to changes in the lagoon. One Kotzebue elder explained:

Right now we don't care about it, that *Akulaaq* fishing. Because it's a different outlet now. That outlet used to be way out here, close to that grave site, used to be way over there. Right now it's way out here [at the other end]. And it's a pretty small place to have fish, I believe. We never fish over there for a long time. We used to set net, all right, and get those little *tipuaksraq*. They're small *tipuk*, those good ones, those good little fish. Used to have good fish. They don't grow like those big *tipuk* we get once in awhile at *Anigaaq*. They're smaller.

Bering cisco are also known as the only fish that can be caught in spring with small hooks through open cracks in the ice in Krusenstern Lagoon. Although rarely done, this provided an important





James Magdanz

Figure 4-10. Round whitefish, upper Kobuk River, September 2002. Found mainly in upriver areas, round whitefish are widely viewed as smelling and tasting different from other kinds of whitefish. Several elders described their taste as metallic. opportunity during times of hunger in the past.

Because of their high fat content, Bering cisco are not made into dried fish, but are instead roasted, salted, or eaten as *quaq* (frozen fish, often aged). "We don't hang *tipuk*—they're too fat to hang," one Noatak elder said. Another fisherman from Kotzebue said:

We don't dry *tipuk*. It's too oily to dry. But it's a real good fish—just throw it in the oven.

Round Whitefish Prosopium cylindraceum

- Quptik
- Savaigutniq

Like the Bering cisco, the round whitefish has a limited distribution in the Northwest Arctic region. This whitefish was most familiar to residents of the upper Kobuk River and Noatak, and less familiar to residents of Noorvik on the lower Kobuk River where it is found in only scattered numbers. Selawik and Kotzebue residents had little if any experience with this fish. The round whitefish is predominantly known throughout the region by its Iñupiaq name *quptik*, although in Noatak some residents called this fish *savaigutniq*.

Scientists consider round whitefish a predominantly freshwater fish, rarely found in brackish water (Mecklenburg et al. 2002). One Kotzebue respondent described round whitefish as "primarily a fish of gravel-bottomed streams," explaining their greater abundance in upriver areas such as Shungnak and Noatak and their scarcity or absence in the mud-bottomed waterways near Selawik and Noorvik. One Noorvik elder said:

We have very few *quptik* [round whitefish]. In springtime we get *quptik* but only one in a thousand. The whole summer we can see them. We eat them. They taste like *qaalģiq* [humpback whitefish] and we cut them like *qaalģiq* to dry.

The round whitefish was described by respondents as a small whitefish, distinguishable in part by its orange-colored fins in the

fall. Scientific literature similarly describes anal and pelvic fins of round whitefish as "sometimes amber, becoming orange at spawning time" (Mecklenberg et al. 2002). Round whitefish were widely regarded by respondents as smelling and tasting different from other kinds of whitefish. One Shungnak elder said:

Their taste is way different than these other whitefish. Just like you kept something in tin, in a tin can too much. They taste like a wet table knife.

Noatak elders similarly described them as having a metallic taste, and were careful not to store them in the same gunnysack as other fish. Others compared their taste to gasoline, and the taste of their eggs to moss. One Kobuk woman, explaining why round whitefish eggs tasted like they had been in a tin can too long (*savi}haqsuġnich*), said that when these fish travel up the river they stop in an area of slow current and sit still with no activity or movement. This elder elaborated:

The fish parks itself on the red-orange colored sand in the winter and stays there. Then its eggs get the taste of metal. They have told us this.

A Kotzebue elder offered the following explanation:

Their habit of feeding on rotted salmon flesh apparently is one thing that causes *quptik* [round whitefish] to not only have a bad taste themselves but they can influence a sack of fish at the time when your sack of fish is not freezing right away. There's a warning not to put any of those kind mixed in with your whitefish. *Quptik*, by the way, is pretty strictly freshwater. Apparently they don't wander very much.

Although not a preferred fish, round whitefish were nonetheless reported to be fat and to be good for *quaq* (frozen fish, often aged). They were also sometimes fed to dogs, or occasionally eaten as *paniqtuq* (dried fish) by some people. Because of their metallic taste, round whitefish eggs were not used for *ittukpalak*, a traditional Eskimo dessert made with whipped fish eggs and cranberries. Where they are found, round whitefish are caught with other whitefish, particularly humpback whitefish in both spring and fall, but only in small numbers. Some fishermen release round whitefish caught in a seine. According to one Shungnak elder, when many round whitefish are caught in a seine, other fish are not likely to be in the area. She said:

When there's no fish where you always seine, if you catch that kind [round whitefish] there's not many fish there. They want to be by themselves, I think. That's what I heard. Sometimes when we seine and just get *quptik* [round whitefish], they would say there's no fish there. I don't know why.



Shungnak and Kobuk residents said round whitefish range far up the Kobuk River. These respondents were uncertain about the timing of spawning for round whitefish, with some thinking it was in the fall and others believing it was spring. In Noatak, round whitefish are occasionally caught in winter while fishermen are hooking for trout (Dolly Varden). They are found year-round in the Noatak area.

Seasonal Movements of Whitefish

The seasonal movements of whitefish are complex, and not fully understood. These movements vary by geographic location, by species, and even by fish within species. Different age groups of fish of the same species might make different seasonal movements. Whitefish are found in a wide variety of habitats, and their movements among these are not sharply defined. Experienced subsistence fishermen are knowledgeable about the location and timing of whitefish in the traditional fishing areas of their village and their family, but where the fish go when outside this familiar territory is usually a matter of speculation. The following descriptions of whitefish movements were assembled from the many observations offered by key respondents during the interviews. For clarity the material is organized by geographic area.

Selawik River Delta

According to Selawik respondents, whitefish move seasonally, migrating between the rivers and the lakes. Many people described whitefish as moving from lakes into rivers in spring and from rivers into large lakes in fall. Others described the movement in reverse order—that whitefish move into lakes in the spring and out of lakes in the fall. Perhaps both are correct, depending on the species and the exact location and timing. At break-up, for instance, whitefish might be moving out of large wintering lakes and into small summer feeding lakes. In later summer some whitefish might be migrating from lakes to spawning grounds in the rivers, returning to the lakes near freeze-up for the winter.

Respondents commonly said that the spring movement of whitefish out of the lakes begins as soon as the ice breaks. "Whitefish come in right after the ice goes," one woman observed. Another explained that in summer whitefish "will be all over in the river. All the way up, all the way down." The fall migration of whitefish back into the lakes begins in September before freeze-up and continues under the ice after freeze-up. Whitefish winter in the lakes,

becoming less available to fishermen in the latter part of the season (January to April). One elder said, "After January, there's hardly any whitefish. Maybe they sleep or something, or take a break." Another elder believed that whitefish are still around at that time of year, but thick ice makes it difficult to fish for them. In late winter, Selawik residents focus their fishing efforts on hooking for northern pike and sheefish.

Selawik respondents also said that whitefish prefer to live where the water is deep—unlike northern pike, which are often found in shallow water. One elder explained:

That's where the little fish run around [in shallow water], and pike catch the little fish to eat them. But these whitefish are not that way. They don't eat other fish.

In the summer months, whitefish also prefer the coolness of deep water. One man said, "I think they like it cold. Sometimes when it's too hot, the fish flip over and die like that by the lakes." Another respondent observed that whitefish die easily in a net when the weather is hot.

Kobuk River Delta

In the Kobuk River delta, whitefish move seasonally between the lakes and the river with much of this movement occurring during two seasons: spring through early summer and fall through early winter. Noorvik respondents described several stages of whitefish movements. Immediately after break-up whitefish move into lakes during the high waters of spring run-off. Those in small lakes and sloughs stay only a short while, leaving the lakes early. Whitefish in the larger lake systems stay until late June or early July, at which time many leave for spawning grounds on the upper Kobuk River. Many other whitefish, however, spend the summers in the lakes. Those that spawn upriver return to the delta in late fall or early winter to overwinter in lakes in the Noorvik area. Respondents noted that *qausriluk* (broad whitefish) appear first in under-ice nets, followed by *qaalgiq* (humpback whitefish).

Noorvik residents associate the spring movement of whitefish with the water level of the river and with the wind direction. Two Noorvik elders offered the following explanations:

When the high water goes into the lakes from the river right after break-up, the fish go into the lakes. When the water turns around in later June, the fish go out of the lakes. They follow the water. You know the small lakes and sloughs? They come out right away from there. Sloughs with a lot of lakes in the back, the whitefish start coming out around July 4th.



In springtime after the ice breaks, we always go down to camp and start catching *qausriluk* [broad whitefish] right away. And in the first part of July, lots of *qausriluk* and [humpback] whitefish start coming out, along with pike. Around July 4th, they really start coming out. Sometimes they are later. For two or three weeks they really come out. They sure know the water. When the water starts going in [to the lakes] from high water and wind near Kotzebue, the fish stop going out [of the sloughs]. When the water drops or it's east wind and the water goes out of the slough, the whitefish really start running. They know the weather. You have to have the right wind, east wind. Even when hooking [through the ice].

One woman associated the timing of the whitefish out-migration from the lakes with the willows along the river producing their downy white seeds. She said:

My mom always said that the fish come out when the cotton flies [from the willows]. Some of the fish come out earlier from some of the lakes, but they really come out when the cotton flies. Sometimes our nets are so heavy we can hardly pick them up.



Researchers heard a similar statement from an elderly Shungnak woman. It was June 7 and this woman, looking out a window, commented that the willows across the river "looked like snow" because they were turning white with seeds. She said, "When the wind blows, the cotton will start blowing around and at that time the whitefish will come out of the creeks."

As in the upper Kobuk, fishermen in Noorvik distinguish "lake" fish from "river" fish by the contents of their stomachs. This is indicative of the recent habitat, feeding behavior, and movement of individual fish. One woman said:

The ones that stay in the lakes are fatter than the river ones. The fish in the lakes have food in their stomachs when they first come out—real fat stomachs. The first ones that come out have full bellies. Later in spring they're fat but their stomachs are empty. Real fat—it's a good time for boiling stomachs for fish oil. That's the time to make fish oil.

Figure 4-11. Sunii Jackson and James Ramoth wait to re-set a whitefish net under the ice in Selawik, November 2002. Winter fishing for whitefish in Selawik often takes place in front of or very close to the village.

Upper Kobuk River

The movements of whitefish in the upper Kobuk area seem particularly complex, perhaps because this is a major spawning area for several whitefish species. One Shungnak fisherman said, "Like sheefish, whitefish go up and down the river," but the seasonal movements of sheefish are distinct and straightforward compared to those of whitefish (Georgette and Loon 1990). Whitefish not only move between lakes and rivers during the ice-free months—and possibly under the ice—but also migrate up and down the Kobuk River to spawn. Some are resident in the upper Kobuk area. Fish of the same species can be found in each of these patterns, with upper Kobuk residents distinguishing between "lake" fish and "river" fish. Interesting to note is that residents of the Kopukuk River—a Yukon River tributary just south of the upper Kobuk—had observations of whitefish movements in their area quite similar to those of upper Kobuk respondents (Andersen et al. 2004).

In spring, the first movement of whitefish is out of lakes immediately after break-up. According to one knowledgeable elder, *qausriluk* (broad whitefish) are the first to leave the lakes, followed by *qaalģiq* (humpback whitefish) with pike and suckers leaving the lakes together last. One fisherman said:

They know when the river breaks up, I think. They know. They must have some kind of sign when they start going out.

To catch these fish, upper Kobuk residents set short gillnets soon after break-up near the mouths of small creeks, particularly those draining tundra lake systems such as *Kuutchiaq, Saiyuuq, Aviļutquġruaq, Tayaġaralik, Tikiġasrugruk, Uqquqłiq,* and *Isruq-tauraq*. Additional early spring fishing sites include *Kaŋiġaaġruk, Umittaq, Itnauram Kuvraqtuqvai,* and *Sirraqniqruaq*. At this time of year, broad whitefish in particular are very fat. Upper Kobuk residents believe that fish leaving the lakes at break-up wintered in deep areas of these lakes. One elderly Shungnak woman reminisced about catching fat broad whitefish in lakes near *Kuutchiaq* when she camped there in past years during the break-up season. She described these as "fat fish with a moss taste," an indication that they likely wintered in the lakes.

The second movement of whitefish takes place near the end of June when fish that wintered in coastal waters or in the lower river begin arriving in the upper Kobuk after an upstream migration. The first to migrate upriver are humpback whitefish, arriving in the Shungnak area soon after July 4 along with or somewhat before sheefish. Local residents begin fishing for them in modest amounts at this time. In mid-summer humpback whitefish are found in eddies,

moving to swifter water and sandbars later in fall when spawning time approaches.

Least cisco (*qalusraaq*) move into lakes to feed soon after breakup, then move out of lakes in the fall to spawn. Shungnak elders offered the following two observations:

We notice them coming up early in the spring. They go up on the side of the river, making little ripples, just like *qayaq* [kayak]. Early in the springtime.

We used to see *qalusraaq* [least cisco] go into Black River right after break-up. They spend the summer feeding in the lakes. Then they go into the Kobuk River to spawn.

Respondents often remarked on the abundance of least cisco running into the lakes in the spring. "You can see them like a stream going in," one said. Least cisco coming out of lakes in the fall are reliably fat. Little was said or known about the movements of the less important round whitefish (*quptik*).

Broad whitefish (qausriluk) movements are also complex, with upper Kobuk residents describing several patterns. Some broad whitefish move out of nearby lakes in spring, spend summer and fall in the upper reaches of the Kobuk River, and then return downriver to the Shungnak area after freeze-up to spawn. Local residents not only catch broad whitefish coming out of lakes in the spring, but also occasionally catch them in summer in deep places in the main river while seining for humpback whitefish. Other broad whitefish move into lakes in the summer to feed, then return to the main river in late fall to spawn. And finally, many broad whitefish spend the summer elsewhere in the region, undertake an upstream migration late in the season, and arrive in the Shungnak area under the ice after freeze-up. Upper Kobuk residents are not certain from where these fish originate, but often suggest "the ocean" or lakes near Kiana and Noorvik. Several respondents spoke of the difference between "the lake kind" and "the river kind" of broad whitefish, particularly in regard to the contents of their stomachs and the taste and appearance of their meat. Broad whitefish summering in nearby lakes have food in their stomachs and flavorful, often darker meat, while those migrating upriver have "clear" stomachs and less tasty meat. One elder said:

The ones that come from the lakes . . . taste different from the ones coming upriver. They smell like lake water. We could tell it's from the lake by the taste. . . . The river kind, they don't taste like anything.

Another elder described:

Qausriluk [broad whitefish] come out of the lakes in the falltime at



Figure 4-12. Tubs of whitefish, mostly humpback, ready for cutting. It is not unusual for upper Kobuk women, such as Vera Douglas (above) to cut and hang hundreds of fish in a day or two. These whitefish were seined earlier that day. Tubs like these hold an average of 70 fish each.

Black River. The Black River *qausriluk* taste altogether different than the ones caught under the ice. They are fat, with a moss taste to it. Their stomachs are full of worms, short black ones that look almost like beetles. Also with shells, small shells like snails. The Black River *qausriluk* are good eating, especially when aged and eaten frozen. They don't freeze hard [because they are so fat]. They come out in late August or September until freeze-up.

After spawning, most broad whitefish go back downriver. "The *qausriluk* [broad whitefish] always go down in falltime when it is part ice," one Kobuk elder said. However, because broad whitefish are netted coming out of lakes at break-up, upper Kobuk residents believe that at least some must winter with other whitefish in nearby lakes. After spawning late in the fall, humpback whitefish also move to wintering areas, mostly in lakes near the delta although a few stay in upper Kobuk area lakes.

In mid-winter, whitefish are generally not available in the upper Kobuk area, except perhaps in lakes. "There are not really many around here in winter," one elder said. Local residents do not fish for whitefish in mid-winter, but believe that one probably could if necessary. A few elders described finding broad whitefish in winter in lakes near Pah River and in Norutak Lake in the Kobuk River headwaters. One elder said that broad whitefish in the latter lake were so fat year-round that "when you cook them, you don't use any lard or grease. The grease of themselves you use."

Noatak River

Noatak residents described four major patterns of whitefish movements, and there may well be more that went unstated. The first of these occur in spring when high water brings whitefish into the lakes on Noatak flats, stranding them there as the water drops. "There are lots of whitefish in the lakes in the flats," one man observed. At about the same time, at least some of the whitefish that overwintered in the Noatak area are flushed out of the river by the high water to coastal areas near Kotzebue. A third movement takes place in July when whitefish begin to return to the Noatak River, moving upriver from the mouth. At this time of year, Noatak fishermen often travel downriver to intercept the migration and seine whitefish to make *paniqtuq* (dried fish). One elder noted the sequence of fish moving up the Noatak River in summer: "Whitefish come first, then salmon, then trout." Many Noatak families summer along the coast at Nuvugraq near Kotzebue, and one elder explained the relationship between whitefish there and in the Noatak River:

If you get to *Nuvugraq* early, in early June, you can get whitefish. They're good for making dried fish. If you fish for them later in

July at *Nuvugraq*, you can only get a few. The whitefish are headed to the Noatak, and people here [in the village] go downriver to seine them.

A fourth movement pattern occurs in late fall when whitefish move downriver, but whether this is to spawning areas or wintering areas, or both, is not clear. This late fall movement includes broad whitefish moving out of *Narvaġruk* (Lake Narvakrak) east of *Kuugruaq* (Kugururok River), as well as humpback whitefish moving downriver from this and other summer feeding areas. One respondent noted, "In the fall, the trout are going upriver and the whitefish are going downriver."

In winter, humpback whitefish and round whitefish are occasionally caught through the ice by residents fishing with hook-and-line for trout (Dolly Varden). "You can always get whitefish in the winter, but they're not very fat," one elder said. Another elder explained:

Whitefish spend the winters in the river. You can make a hole in the ice and see lots of whitefish. *Quptik* [round whitefish] smell like lake fish. You can catch them in the river right now [in February].

Broad whitefish, however, are not available in the Noatak area in winter. "They go somewhere, maybe downriver," one man said.

Coastal Area

The seasonal movement of whitefish described by Kotzebue respondents pertained primarily to the lower Noatak River and to the coastal area northwest of Kotzebue near Sisualik and Cape Krusenstern. After break-up in spring, whitefish move about in a number of ways. Some move out of lakes and sloughs, particularly in the *Sivisuuq* (Sevisok) area on the Noatak flats but also from other areas on the Baldwin Peninsula and near Kobuk Lake, riding the high water downriver to the coast. One Kotzebue fisherman explained:

Every spring whitefish come out of the lakes. The mouth of the lakes open up before the whole lake thaws. The ice on the lakes stays forever. They come out of the lakes by the millions in the spring. But you have to get them quickly. By the time Noatak people can come down [to the Eli River because of the ice], the whitefish are gone.

Other respondents said that whitefish move into the lakes in the spring, but whether this occurs before, after, or concurrently with whitefish moving out of the lakes is unclear. One Kotzebue elder speculated that in spring whitefish might leave wherever they overwintered to seek new feeding areas, explaining why fish might be

both moving into and out of lakes simultaneously.

Spring high water also opens the mouth of the Krusenstern lagoon system at *Anigaaq*, which in most years is closed by beach gravel during the preceding summer. Whitefish flushed out the No-atak and other rivers by high water follow the coast near *Nuvugraq* and Sisualik. One Noatak elder said:

A bunch of them [*Anigaaq* whitefish] that stayed up here during the winter go out from Noatak River right at *Nuvugraq*. Lot of them!

These whitefish soon find their way into coastal lagoons such as *Akulaaq* and Krusenstern to feed. In these lagoons the fish fatten up quickly, and by July begin to leave the lagoon systems. If beach gravel closes the outlet at *Anigaaq* by mid-July or so, large numbers of whitefish become trapped in Krusenstern Lagoon. However, if the outlet does not close until August or later, or if it closes and is later breached by a storm, large numbers of whitefish escape the lagoon and travel back along the coast to the Noatak River and elsewhere.

In late fall whitefish leave the lakes and, where possible, the coastal lagoons to migrate to spawning areas. In some areas this can happen quickly. One Kotzebue fisherman said:

Sometimes the whitefish come out in one shot. You got to watch. They come out in about three or four days. They come out from *Aliiqtuġnaq* [Aliktongnak Lake] and the other lakes around there [on the Noatak flats]—they are all connected. The fish are full of eggs. Those fish with eggs go spawn somewhere.

Broad whitefish summer in a slough called *Qayaqtuaġvik* not far upstream from the mouth of the Agashashok ("Aggie") River, and also in a slough called *Nunaksrak* on the west side of the Noatak River below the Eli River. One elder said:

Qausiluk [broad whitefish] come out of a slough called *Qayaqtuagvik*. Where they come out, the creek is not wide. They go in in the spring and come out when it gets cold.

Another elder described a regular run of egg-laden broad whitefish along the north shore of Kobuk Lake, roughly between the Little Noatak and *Ivik*. This usually occurs between October 10 and 20—either just before ice forms or soon after. This fisherman described the run "as a benefit peculiar to that area. It's the reason for people being there at that time of year." Where these fish originate from is not known, but this elder speculated that they come from lakes scattered along the lower Noatak as far upriver as the Noatak flats.

Several respondents mentioned a connection between the number



of whitefish impounded in Krusenstern Lagoon and the abundance of whitefish in the Selawik, Noatak, and Kobuk rivers. Elders in Kotzebue and Noatak offered the following three observations:

Most of those fish go to Selawik area, the ones we have [at Krusenstern Lagoon]. Years ago those old people [in Selawik] said—when *Anigaaq* close up—they said they won't have much fish because they go inside *Anigaaq*. And when it's open like this, they say they're going to have lots of fish. That's what they always say. *Anigaaq* always steal the fish.



When *Anigaaq* is open, Noorvik and Kiana people be plenty happy. Fish go all over up there, then come back again [to *Anigaaq*].

Sometimes when *Anigaaq* is closed on the main ocean, we don't have that much [fish] up here [in Noatak]. There is, but not that much. And if it's open down there, we got all kinds of whitefish, all kinds. But they're not as fat as at *Anigaaq*. If you catch them down at *Anigaaq* before they travel, you get nice, white, fat fish down there. When they travel up Noatak River, they get skinny.

Jim Magdanz

Figure 4-13. Sisualik and Nuvugraq, important summer settlements on a large spit about 10 miles northwest of Kotzebue. The photo was taken in September 2003, after many of the seasonal residents returned home to Kotzebue and Noatak.



Figure 4-14. Three examples of least cisco eggs, ranging in color from pale pink (left) to bright orange (right), taken in the fall in the upper Koyukuk River near Allakaket. In the Kotzebue Sound region, elders described variety in egg color as a distinctive feature of the least cisco.

But they're still good. They go spawn up here.

Spawning

Respondents widely knew the spawning season of the major whitefish species because they catch these fish when their eggs "are spilling out like water." Fewer people were familiar with spawning locations. This was especially true in Noorvik, Selawik, and Kotzebue, though a few elders in these communities had some knowledge of spawning areas. In general, upper Kobuk residents were most familiar with spawning locations and with the details of the timing of spawning, indicating that the upper Kobuk River is a major spawning area for whitefish as it is for sheefish and chum salmon. In addition, whitefish fishing is a major focus of fall subsistence activities in the upper Kobuk, and thus residents are particularly knowledgeable about this resource during this season. In Noatak, respondents were somewhat familiar with whitefish spawning locations, an indication that whitefish likely spawn in this area as well. Unlike the upper Kobuk, however, Noatak fishermen focus more on the harvest of trout (Dolly Varden) than on the harvest of whitefish in the fall.

Broad whitefish, humpback whitefish, and least cisco all spawn between late fall and early winter. The sequence is as follows, according to upper Kobuk respondents. Humpback whitefish (*qaalġiq*) are the first to spawn in the fall. They spawn with sheefish at night in the main river sometime after September 20 and before freeze-up. Some spawn later. "They're real noisy and splashing," one elder described. Least cisco (*qalusraaq*) spawn in the upper Kobuk area in late September or early October at the same time as
or shortly after sheefish and humpback whitefish. Broad whitefish (*qausriluk*) are the last of the whitefish to spawn, typically at the end of the first week of November, according to an experienced under-ice fisherman in Shungnak.

One of the distinctive characteristics of least cisco is the variety in their egg color. Some fish, for instance, have yellow eggs and others orange, pink, or white eggs. One elder described coming across a small slough full of least cisco in Shungnak River in the fall:

You could hardly see the bottom. The banks were just covered with *suvak* [eggs]. It looked like rickrack. The fish had spawned too close to the bank and the eggs had stuck on the mud. Lots of colors were zigging up and down.

Biologists do not dispute that the color of the meat and eggs of individual fish can vary. For instance, egg color in salmon has been shown to be related to both food and genetics. In the upper Kobuk, least cisco feeding in different lakes with different invertebrate fauna could well produce eggs of different colors (Randy Brown, USF&WS, pers. comm., 2003).

Little was known about the spawning habits of round whitefish (*quptik*). In the upper Kobuk, respondents were uncertain about the timing of spawning for these fish, with some thinking it was fall and others spring. One Noatak elder believed that round whitefish spawn slightly later than humpback whitefish. Similarly, no respondents had any information about the timing or location of Bering cisco (*tipuk*) spawning, although Kotzebue fishermen puzzle over this at times. The scientific community likewise has little information on the spawning habits of Bering cisco in this region. Scientists generally believe that Bering cisco spawn in the Yukon River system, even those from as far away as the Barrow area, which would explain the lack of locally known spawning areas in the Kotzebue Sound region (Bickham, Patton, Minzenmayer, Moulton, and Gallaway 1997). Further scientific investigations could shed additional light on this question.

For the most part, respondents were not specific about spawning locations for whitefish. Upper Kobuk residents catch egg-laden whitefish throughout their fall and early winter fishing area, which generally extends from Black River below Shungnak upstream to Pah River. *Katyaak*, about 12 river miles below Shungnak, is a key location for the under-ice harvest of spawning broad whitefish. The scientific literature describes one major spawning area for humpback whitefish located about 25 to 40 miles above Kobuk village in the main Kobuk River (Alt 1979). In Noatak, respondents mentioned the Noatak village area and the Kelly and *Kuugruaq* (Kugururok) river areas as whitefish spawning sites. Noatak elders offered the



Figure 4-15. Selawik students eager to eat fresh least cisco eggs, Selawik Culture and Science Camp, September 2003. The eggs of least cisco (qalusraaq) are considered a tasty treat throughout the region.

following observations:

Whitefish come out of *Narvaġruk* [Lake Narvakrak] with a bellyful of eggs. They don't spawn there. They spawn around here [Noatak village] someplace.

Right along Kelly [River], inside Kelly and above Kelly, down below those first canyons we have, whitefish spawn around there. On the main river, or right along it mostly. *Kuugruaq* [Kugururok River] area, too. Right there. And these whitefish are also along the Noatak area, right here. . . . Soon as it gets cold up here, they spawn.

When we seine for these [whitefish] in the fall in September, they are just getting ready to spawn. Late in the fall they really spawn their eggs. We try to get them before they start spawning—we like the eggs, too.

Most Selawik respondents did not know where whitefish spawn, an indication that these fish probably do not spawn in the lower Selawik River. Some speculated that whitefish spawn in lakes in the fall. The few Selawik elders familiar with whitefish spawning areas, however, cited the upper Fish River, *Sinjagruk* (Singauruk River), and the upper Selawik River as spawning locations for humpback and broad whitefish. The upper Selawik River is also

a sheefish spawning ground. These are all relatively shallow, gravel-bottomed sections of river—the type of habitat preferred by spawning whitefish, but not common in the Selawik area (Alt 1979). One elder said:

These whitefish have clean stomachs—you can eat them right away. When they come out from these places [after spawning], they are not in good shape. They are good for dog food.

In Noorvik, respondents did not name any particular places for whitefish spawning, other than "upriver" or "downriver." Several fishermen remarked, however, that broad whitefish caught under the ice are full of eggs, more so than humpback whitefish. It might be that in fall on the lower Kobuk River broad whitefish are moving upstream to spawn while humpback whitefish are beginning to arrive in downstream wintering areas after spawning; this, however, is purely speculation on the part of researchers. The following are observations of two Noorvik fishermen:

In the last part of September, October, and November, we set a net under the ice. At that time, sheefish we catch have no more eggs. They always go way upriver to spawn. Early in the season—October—under the ice, whitefish are full of eggs, especially *qausriluk* [broad whitefish]. Their eggs are coming out as we take them out of the net. Those other whitefish [humpback] are called *qaalgiq*. They have eggs, too, in the fall.

Qausriluk [broad whitefish] have eggs in the fall. In June, July, *qaalģiq* [humpback whitefish] have *suvak* [eggs] in them. They hardly have any *suvak* when we fish in springtime. *Qausriluk* come first under the ice, then *qaalģiq*. *Qausriluk* especially have eggs in the fall. *Qaalģiq* not so much.

The coastal lagoons where Kotzebue residents catch whitefish in the fall were not believed by respondents to be spawning areas. Rather, egg-laden whitefish are eager to leave these lagoons in fall for spawning areas elsewhere, accounting for their dense congregations at the lagoon outlets. Many Kotzebue respondents wondered where these fish spawn if unable to escape the lagoon. Several pointed out one area in the Krusenstern Lagoon system where they believe humpback whitefish—and perhaps other whitefish species-spawn and attempt to overwinter when gravel closes the outlet, trapping the fish. This area is near a lone stand of cottonwood trees along Tuksruk (Situkuyok River), a clearwater stream draining a portion of the Igichuk Hills (see Fig. 5-22). Four Kotzebue men recounted separate experiences at this place, mostly in the winter when traveling by snowmachine they unexpectedly came upon thinly-iced or open water packed with whitefish at this site. In one instance, three travelers filled a 14-foot basket sled five times with

whitefish, and still the fish were plentiful. Picking up thin sheets of ice, these men saw whitefish packed in sideways "like sardines" with just a small amount of water running over them. In another instance, a Kotzebue resident traveling by snowmachine in March came across open water full of whitefish at this site. He said:

The water was only about this deep [gestures about one foot]. The water didn't freeze. We got about a gunnysack of fish—*qaalģiq* [humpback whitefish]. The open area of water wasn't very big. I don't remember, but it must have been a year when the fish were trapped at *Anigaaq*. The water wasn't even frozen. The fish must have kept it open. I ride back there almost every year, and I've been there many times when it's frozen. The fox and otters found it, too. There were tracks all over the place.

Others similarly believed that the mass of fish keeps the ice thin because in other years this area is solidly frozen. The general consensus among respondents was that whitefish congregate there in years when large numbers are trapped in the lagoon system and gradually driven upstream by thickening ice at the outlet. This occurs with a fair degree of frequency, but not every year. Biologists speculate that *Tuksruk* (Situkuyok River) attracts fish because it is the first oxygenated stream they encounter (Charlie Lean, NPS, pers. comm., 2003). This area of the river is also known to have springs. Whether whitefish are successful at overwintering at this site is not clear. Spring bird hunters have reportedly seen dead fish in this area, though key respondents had not widely observed this. Foxes, other animals, and birds might be efficient enough at cleaning up fish carcasses that evidence of fish die-offs might not remain long.

A Kotzebue elder once observed spawning humpback whitefish at this *Tuksruk* site in the fall. Other species might have been present as well, but were not clearly evident. Whether this spawning is successful is not known. Another Kotzebue elder, when asked if he had seen spawning whitefish, responded:

Not really. I never see any. I never really try to find out where they're spawning. But old people always say they always spawn way up the river that goes up *Anigaaq* area, that right side river, that clear one [*Tuksruk*]. That's where they always go for spawning.

One Kotzebue fisherman has observed "lots" of least cisco in September in a small slough or lake system on the east side of the Noatak River between the mouths of *Sivisuuq* (Sevisok Slough) and Eli River. Whether these fish spawn or simply summer here is not clear.

Many fishermen noted that late in the fall whitefish scales become rough. Upper Kobuk residents call this *atigirut*, or "putting on



a parka," and consider this a sign that freeze-up is near. "When the parka comes on, we know it's falltime," one woman said. Humpback whitefish were widely known to get rough scales, but upper Kobuk respondents were less certain whether broad whitefish and least cisco did so as well. One elder said:

Just before whitefish spawn and start downriver, they get rough on their skin. That's how we know it's late and they're ready to go downriver. You notice their eggs are real big. The meat gets different when you eat them. It gets watery. Both males and females get rough. They are real smooth when they first come up in spring.

In Noorvik, fishermen likewise noted these rough scales on both broad and humpback whitefish. One Noorvik woman said:

In falltime, whitefish skin gets rough. I always think that maybe that's their winter covering. Like caribou in the fall getting thicker coats.

Selawik and Noatak fishermen also reported finding whitefish with rough scales in late fall. A Kotzebue fisherman said he rarely sees whitefish with rough scales at *Anigaaq*, but that this change is common when fish reach Selawik. He explained:

Those fish when they go up to Selawik area, they become just like flounders. When you work on them, they get like sandpaper. They have a different feel. Their skin. Just the skin. They're the same kind of fish we have, but their skin changes. Rough, just like sandpaper. Real thick sandpaper. And they're not tasty like whitefish we have. I believe the water changes them. We don't have any rough fish at *Anigaaq*. I think because it's close to the ocean side—saltwater.

Figure 4-16. A male humpback whitefish with pronounced pearl tubercles on its head and scales, Selawik, September 2003. Appearing a short while before spawning, tubercles make the skin of the fish feel rough, "like sandpaper." For upper Kobuk residents, these rough scales are a sign of impending freeze-up.

Scientists call these rough scales "nuptial tubercles" or "pearl tubercles." They usually develop in humpback whitefish a short while before spawning and are typically more pronounced in males than in females, sometimes appearing as distinct white bumps on the males' heads and scales (Randy Brown, USF&WS, pers. comm., 2003). Male broad and round whitefish also develop prominent tubercles (Mecklenburg et al. 2002).

Little was known by respondents about juvenile whitefish. Although fishermen in all the communities often see small fish in the water, they could not for the most part distinguish these tiny fish by species. Selawik residents said they find juvenile whitefish in the stomachs of northern pike, and speculated that these young fish live in the muddy, grassy shallows of the lakes. One Noorvik woman said: "After break-up there are lots of small fish [a couple inches long] going upriver. Millions of them."

Abundance and Health of Whitefish

In all the study communities, most respondents agreed that whitefish were abundant and could not recall a time when this was not the case. "There have always been lots of whitefish," several people commented. Another person said, "Whitefish never seem to run out. There are always lots. They don't seem to go up and down." In Selawik, several respondents pointed out that the local environment is full of waterways, offering many different locations suitable for fishing. One man explained:

We always have fish. If you can't get fish in one place, you can try somewhere else. There are always places to try and get fish.

Successful whitefish fishing by Noatak, Selawik, and Kobuk River residents is determined far more by weather and water conditions than by abundance of fish. High water makes it difficult or impossible to seine or set nets, and wet weather makes it difficult to dry and store fish. Elders from Shungnak and Noatak offered these observations:

One year I remember, maybe 1955, everyone was hungry. We never get fish. There was high water, and we couldn't dry fish because of rain. No caribou at that time. We only had ptarmigan to eat.

High water, we get no fish. High water, there's no time to do seining. No gravel [bars] to do seining. I know that. I don't know how many times when I was small. We didn't get no salmon, no dog feed. We used rabbits for the winter. Did a lot of rabbit hunting for dogs. And ptarmigan.

While high water presents problems for fishermen, it is not a

problem for the fish themselves. According to upper Kobuk residents, whitefish do not mind high water because it makes it easier for them to go downriver, and it makes it harder for them to get caught. "They're happy with high water," one Shungnak elder said.

Respondents offered somewhat mixed views on whether the whitefish population was increasing, decreasing, or stable. Some respondents, particularly in Selawik, believed that whitefish were less abundant now than in the past, a decline largely attributed to the negative impacts of beaver on whitefish. Many others in the region believed that whitefish had increased in number over their lifetimes primarily as a result of decreased human harvests. Elders from Noorvik and Noatak offered these two views:

Whitefish are about the same in number. Maybe there's even more right now. People used to fish all summer long for their dogs. They seined all summer every day to dry up fish, any kind of fish for dog food. People used to use fish traps all along the Kobuk River at freeze-up. Now we just try to get enough for the winter. We used to make sticks of 25 [humpback] whitefish and 20 *qausriluk* [broad whitefish], and get 100 sticks a day. That's how much fish we used to catch. We used to get *qalusraaq* [least cisco] for dog food. People don't do that much anymore. Everyone used to have their own dog team, almost everyone. Around here it was pretty hard not to have dogs. You had to have a way to get around.

People have always fished for all species of fish in the river, and they still have lots of fish. Probably whitefish are about the same [in number] as before, maybe even more because people don't fish for dogs like they used to. People used to catch lots of fish for dogs. They catch less now than they used to. There was no main food for dogs—people fed them a variety of food, depending on what was available. Dogs liked variety, just like people.

Although whitefish were believed to be consistently abundant, the same was not true for salmon. These were regarded as variable in abundance from year to year. "Sometimes the salmon always be less, and sometimes it always be real lots," observed one Shungnak fisherman. An elderly Kobuk woman recalled a year when very few salmon reached the Kobuk River:

I don't know the year. I could not write then. The salmon did not come up the Kobuk then. I don't know why. My mother always said that. Even though they fished with gillnets all summer, they barely filled one pole. She told this whenever she remembered. The salmon did not come up the Kobuk that year. . . . But they got a lot of whitefish. Whitefish were abundant. They got a lot of whitefish that summer.

Despite an overall abundance of whitefish, some respondents noted particular instances of diminished whitefish numbers. For example, one Shungnak elder said:

Pah River, it used to have lot of *qausriluk* [broad whitefish] long time ago. . . . I think those pike eat those whitefish. We used to get lots from that area right there.

A Noorvik woman noted a decline in whitefish in a particular slough her family formerly fished. Upper Kobuk elders commented on reduced numbers of least cisco (*qalusraaq*) in recent decades. "We don't really see these like we used to," one fisherman said. Because least cisco in the Shungnak and Kobuk area are near the upriver limit of their range, some respondents thought the diminished numbers might reflect a slight shift in their range. Other fishermen believed that beaver dams might be responsible, trapping least cisco in lakes when the water is low. One Shungnak elder observed:

Last fall for the first time in a long time we saw those *qalusraaq* [least cisco] come out of Black River in falltime. They came out with the pike. The pike tried to chase them because they wanted to eat them.

This elder thought that a recent decline in beaver dams in the area accounted for the return of least cisco.

In the coastal area near Kotzebue, whitefish abundance is determined largely by the timing of the closing of the outlet to Krusenstern Lagoon, the traditional site of the community's largest whitefish fishery. This outlet, called Anigaaq, is closed each summer by beach gravel transported by wind-driven waves. When the outlet closes early in the summer-in July-large numbers of whitefish that entered the lagoon system to feed after break-up become trapped with no route of escape. This leads to a very productive fall fishery. However, when the outlet closes late in the summer-in August or September-most whitefish have already left the lagoon system, resulting in a meager fall harvest. A late summer or fall storm can also breach the gravel dam at the outlet, allowing whitefish to escape. The same pattern is at work in other coastal lagoon systems near Kotzebue. For these reasons, Kotzebue residents generally did not feel comfortable offering an assessment of the overall population status of whitefish. One respondent said:

It's hard to say how the abundance of whitefish has changed. It depends on when *Anigaaq* closes. Some years there are lots, and some years little. People used to catch lots of them, but it doesn't seem like it has affected their number.

When asked about ways to predict whitefish abundance in the coming season, most respondents had no knowledge of this. However, one Shungnak elder said:

When they have lots of *nuviuvak* [flies], those old people say, "Oh, we gonna have lots of fish this summer." They notice when they have a lot of flies . . . there would be all kinds of fish.

Another elder was familiar with predictions for salmon, but not for whitefish, saying:

My parents used to say that early in the summer, maybe July or June, that if there are small white things like bugs on the water flying around, there will be a lot of salmon. But I don't know about whitefish. I never hear about whitefish.

For the most part, whitefish seem healthy to respondents. Abnormalities in fish are occasionally encountered, but these were generally not regarded with alarm. Fishermen at times come across fish with internal or external lumps, poor color, deformed or absent fins, and unusual scales. At times whitefish are so skinny that the head is larger than the body. Whitefish with abnormalities like these are usually discarded. As one fisherman explained, "As soon as we find something wrong with them, we just throw the whole thing. We don't bother to save them." Another elder said:

If you find one crippled, don't pick it. Throw it in the water. And tell them not to come back. That's what my mother-in-law used to tell me.

Small, white "worms" are regularly found in whitefish flesh by women cutting the catch. Unless excessive in number, these are usually not considered reason to discard a fish. In 2001 upper Kobuk River fishermen encountered this condition more frequently than usual, and samples of humpback whitefish were sent to a pathology lab for diagnosis. The pathology report identified these white objects as the larvae of the tapeworm Triaenophorus crassus. Eggs of these tapeworms are eaten by small water bugs, called copepods. The eggs hatch into tiny larvae. When a whitefish eats the copepods, the larvae migrate from the intestine into the meat of the whitefish, irritating it. In response, the whitefish develops cysts that completely surround each larva. These larvae and cysts are the white worms and objects fishermen find in whitefish flesh. When a northern pike eats the whitefish, the larvae develop into adult tapeworms in the pike's intestine. These tapeworms lay eggs that are shed into the water and eaten by copepods, starting the cycle again. Although unsightly, the larvae found in whitefish do not pose a health threat to people because this tapeworm is not known to occur in humans (Alaska Department of Fish and Game 2001b).

Occasionally a whitefish is caught that is missing its pelvic fins. In the upper Kobuk, this kind of fish is called *umialik*, or "rich man," because its missing fins indicate that it does not have to work hard or swim much. Upper Kobuk residents said that such fish are not rare, and that salmon and sheefish are also found in this condition. A Noorvik woman said, "There have always been fish missing fins,



James Magdanz

Figure 4-17. A humpback whitefish without pelvic fins. Such fish are caught occasionally. In the upper Kobuk, people call them "umialik" or "rich man," because the missing fins suggest they don't have to work very hard.

ever since we were growing up. Whitefish seem healthy."

One Noatak fisherman thought the composition of males and females in the whitefish population had changed in recent years. He said:

It seems like there are more males than females than before. We take the females for the eggs. We save the males for foxes and wolverines. Usually everybody is looking for females. In the past five or six years, I've noticed more males than females. I don't know why. Otherwise, the fish are the same as always—same size, same condition. Whitefish are fat and healthy-looking, not like trout where we find ones that don't look normal.

Feeding Habits of Whitefish

In all the study villages, many respondents were uncertain about what whitefish eat. The most commonly mentioned item was thinshelled, freshwater clams or snails which are abundant in the muddy river bottoms of the Selawik and lower Kobuk rivers. "They always have lots of shells in their stomachs when you gut them," one Selawik woman said. A Kotzebue respondent described whitefish in coastal areas as eating "little white seashells." Another Kotzebue elder said:

A lot of those [whitefish] that go by Sisualik, their stomachs are plumb full of clam shells, the small clams that . . . have gotten up in the mud flats here. When the ice floats in the springtime it breaks the mud up with them and then the clams drop out as it thaws. They have meat in the shells and that's one of the first foods whitefish start fattening up on because very often they don't have anything else in their stomachs but those clam shells as they pass through Sisualik on their way to *Anigaaq*.

In the upper Kobuk, one elder said that broad and humpback whitefish eat *uvilu* (clams or snails) from the lakes, described as "little soft brown shells with little worms inside." Other upper Kobuk respondents suggested that whitefish eat sand or dirt from the river bottom, noting that fish often had little rocks or bits of sand in their stomachs.

Fish eggs, insect larvae, and "bugs" were other items mentioned as whitefish food. Noatak elders offered the following two observations:

Whitefish always have salmon eggs in their stomachs, I think. Maybe they eat little worms, too.

I don't know what whitefish eat. When people use salmon eggs for bait [when hooking through the ice], whitefish always eat them. I don't know what else they eat. Maybe bugs or sand. I don't know. They never tell me.

Respondents, particularly in the Kobuk River villages, repeatedly pointed out that the stomach contents of whitefish varied with the season and the location. In Noorvik, this difference in stomach contents was noted between whitefish leaving the lakes immediately after break-up and those leaving later in the summer. Noorvik elders offered the following two observations:

Qausriluk [broad whitefish] eat small snails. I always find little snails in their stomachs. When they first start running from the sloughs after break-up, their stomachs always be really full of snails. When they really start going out from the sloughs later in the spring, their stomachs are empty. When we seine for them in summer, their stomachs are empty. We make fish oil then.

Sometimes the whitefish stomachs always be clean. The stomachs are good to eat, but we just take the clean ones to eat. Sometimes whitefish have small black bugs in their stomach. They always have a full stomach right after the ice goes out, and later after the ice is gone they start having a clean stomach.

In the upper Kobuk, respondents noted the difference in stomach contents between whitefish moving out of lakes and sloughs and those migrating from downriver. As one elder explained:

The ones that come up the river have clean stomachs. Ones that come out of the creeks have black stomachs. Maybe they are feeding on something different in the lakes. They have a taste to them. Ones caught under the ice have clean stomachs. Nothing in it. Fish from the river have no taste to them. We're used to fish that come out of lakes with a moss taste to them. That's like Selawik. Black River is like tea, like the water in Selawik.

Another Shungnak elder said:

The ones that come from the sloughs, they have black inside [their stomachs]. We got to clean them up to eat. But coming up from the river, they're clear [inside their stomachs]. Like *qaalģiq* [humpback whitefish]. So we could tell the difference from the stomach and the taste. And they're tastier from the lake.

A Selawik respondent noted that spawning humpback whitefish (*ikkuiyiq*) have "clean" or empty stomachs. Subsistence fishermen

like these empty whitefish stomachs because it is possible to cook and eat them right away without first having to clean them.

Whitefish, Beaver, and Other Animals

Beavers are a relatively recent arrival to the Kotzebue Sound region, first moving into the Kobuk, Shungnak, and Selawik areas in the 1950s according to respondents. Before then beavers were found only in the Pah River and in the Kobuk River headwaters. "There were no beaver when we were growing up," one Shungnak elder said. "Only way upriver." One Selawik woman remembered seeing a beaver for the first time in 1952 when she was 11 years old. Beavers have since spread throughout the Kobuk River and Selawik areas and into other parts of northwest Alaska, building dams and blocking streams and sloughs, thus preventing fish from moving freely except during periods of high water. "That's hard for fish," one elder said. Beavers have reportedly built a dam across the upper Fish River near Selawik, preventing access to areas once used by whitefish.

In Selawik, most respondents believed that by blocking sloughs and streams beavers have caused whitefish to decline in abundance. Beaver dams have also reportedly caused some small creeks to virtually dry up except during periods of high water. One respondent noted that the entire Selawik area seemed to be drying up, with water levels in the rivers now lower and lakes and creeks disappearing. Selawik residents have adapted in part to the impact of beavers by changing the areas they use for fishing. One resident said, "It's a good thing we have lots of rivers here."

Several Selawik respondents described their experiences with opening beaver dams and releasing large numbers of whitefish. One man said that after cutting a hole in a beaver dam "for one and a half hours we watched fish going out, and still there were lots. The fish were really happy, just jumping." Selawik residents typically opened dams when they saw numerous trapped fish or when they were catching fewer fish in an area than expected. Fishermen found it frustrating to have only a short time to go fishing and to discover many whitefish trapped behind a beaver dam at the selected fishing site. One woman expressed some reluctance about opening beaver dams. She said:

One time I had the kids open a beaver dam. I let the kids open the dam because the beavers were making holes in my nets. We took the wood from the dam, and dried it to burn for firewood. But the next time we went back, the beavers had built another dam. My mom didn't tell us to take beaver dams down, so I don't teach my kids to do that.



In the upper Kobuk, local residents also occasionally tear down beaver dams, "but the beavers build it right back," as one fisherman observed. Several respondents commented that seal oil and blubber effectively deter beavers from repairing their dams because land animals, such as beavers, do not mingle with saltwater animals, such as seals. One elder explained:

Those beavers don't like seal oil and blubber. They really don't like it. When we break up the dam . . . and when we put blubber somewhere, they won't touch it. No, they won't touch that dam. . . . Old-timers know that one.

Other upper Kobuk elders elaborated, saying that a person cannot even wear *mukluks*, or seal-skin boots, when hunting beavers. In addition, if a hunter puts a beaver into a seal-skin packsack, he or she will have no more success in getting or even in seeing beavers.

For the most part, Selawik and upper Kobuk respondents believed that whitefish can survive behind beaver dams for extended periods as long as there is food. "They just get fat and big," one woman said. However, when not enough food is available, the fish become skinny. One woman who had opened a beaver dam said:

The fish were skinny because they were trapped in the lake so long. We didn't even want to catch them. They had a big head and just Figure 4-18. Qalupiaq (broad whitefish) ready to eat, Selawik Culture and Science Camp, September 2003. The fish are scaled, gutted, scored on the top side, and baked for 40 minutes. In this case, the tails have been removed so the fish will fit in the baking pans. Freshly roasted fish such as these are called "argig."

a bony body. When we cut open the stomach, it was just empty. I guess they ate up all the food that was in there.

A Shungnak elder recalled a time years ago when she saw something white all around a lake by Rabbit Mountain while hunting muskrat in spring. After reaching the lake, she saw it was ringed with dead *qausriluk* (broad whitefish), some of them big. She didn't know what happened to them, but thought a beaver dam might have trapped them too long in the lake. Whitefish trapped behind beaver dams are only able to escape during periods of high water. If there is no high water, the fish stay there for another year. Trapped whitefish were also said to keep the ice thin on beaver ponds, creating a hazard for winter travelers.

Upper Kobuk residents agreed that beavers have been particularly abundant in recent years. Some believed that beavers are beginning to decline in number, having observed less evidence of them in the past year. One fisherman thought the presence of least cisco again in Black River in 2002 might indicate a declining beaver population. "Beaver might be going down," one elder said. "They cut down all the willows around a lake. When they are all cut down, the beaver move out." Others pointed out that animals simply come and go and that with time beaver will no longer be abundant. One elder said:

Later on, they'll go. Hardly beaver again. Old-timers always say those top-of-the-ground animals . . . go back to the ground and rest in there, sleeping. And after four years, they come out again. That's what old people say.

One Selawik elder believed that the growth and expansion of the beaver population has recently slowed, although most Selawik residents remain concerned about the high population of beavers.

Selawik respondents were particularly troubled by the idea that beavers pollute rivers and waterways. Many Selawik residents carry drinking water from the village so as not to have to drink contaminated river water when camping and traveling. One family reportedly did not go to their camp anymore because a large beaver house was now located nearby. Several respondents advocated eliminating or decreasing the numbers of beavers in the area. Some found it ironic that resource agencies were concerned about Selawik fishermen temporarily blocking waterways with nets, but not concerned about beavers more effectively blocking them with dams.

Noorvik respondents reported a growing number of beavers in their area but none yet felt that this had had a substantial impact on their fishing. One Noorvik woman said:

We don't have beaver around here like upriver. We see *iglut* [beaver houses] here and there. There's a big dam in one slough but it never blocked all the slough. We don't have beaver like they do upriver

or like we hear about in Selawik.

In Noatak, the beaver population has also been increasing, and a few residents expressed concern about the impact of beavers on spawning areas for trout (Dolly Varden) and on water quality. Beavers were uncommon in much of the Kotzebue area, and not an issue with respondents. However, one Kotzebue elder said:

I haven't seen beavers yet at *Sivisuuq* [Sevisok Slough], but I hear they start coming up that way. Old people used to say if you see a beaver, kill it. It'll block fish and pretty soon we'll run out of fish.

As far as their relationship with other animals, whitefish were viewed by upper Kobuk respondents as getting along well with salmon and sheefish, but disliking northern pike because these feed on small whitefish. Grayling follow whitefish downriver in fall to eat their eggs, then turn around and head upriver again. River otter are a main predator of whitefish, following them out of creeks in the spring and feeding on them in lakes. "We have lots of otters right now," one elder said. "All over. They know good, fat fish." Mink also prey on whitefish.

Traditional Laws and Lore

Respondents knew of no special rules prescribing behavior towards whitefish. According to a Shungnak elder, only three animals in the upper Kobuk have special rules for their treatment: beaver, black bear, and brown bear. Whitefish, like other fish and animals, must nonetheless be respected by humans. They must not be wasted or left on the river bank. "That's why we have animals today because people respected them," one elder said. Respecting fish and animals also requires that a person not speak badly about them. One upper Kobuk elder told an illustrative tale:

I remember my brother telling a story about how he was fishing with our mom when he was just a little boy. They had caught lots of suckers. Lots! And they didn't have tubs or gunnysacks, so they had to string them on willows. Suckers are hard to string on willows because they have big heads. My brother's hands were getting cold and he was tired, and he told those fish that he hopes he never catches them anymore. Later they tried to seine and there's no more fish in their nets. My brother never forgot that. Fish can hear what you say to them. All the animals can hear. My mama always tell us to watch our mouths to animals.

Respondents in several villages described on rare occasions finding a large egg with a shell, such as a duck egg, inside whitefish when cutting them. This is considered a bad omen, portending death,

sickness, or other misfortune in the family. One Selawik elder said, "Old people always say when you find one like that, just throw it in the water." Another woman, who had been a self-admitted skeptic of this lore, once had one of these eggs drop out and start rolling when she was cutting whitefish. She quickly threw the egg in the water before anybody saw it. Having seen this with her own eyes, she no longer doubted this knowledge.

An upper Kobuk fisherman similarly described "a big ball" sometimes found inside humpback whitefish, and another woman said:

I cut a fish a couple years ago and found a big ball of something in the meat. I showed it to [elder's name] and she threw it in the river right away and started praying to God. I never asked her about it.

When asked whether this is a bad omen, a Shungnak fisherman concurred, "It's bad luck to find a duck egg in a whitefish. We've heard that, but it doesn't happen often."

A fishery biologist consulted about this abnormality reported once finding a similar growth in a least cisco. The growth, composed of several nodules with the largest the size of a golf ball, had no connective tissue and fell from the body of the fish when tipped. The nodules were made of tough fibrous tissue. Based on its description, a fish pathologist speculated that the growth was most likely a fibroma, or benign tumor, of the connective tissue of the ovary (Brown 2003b).

Other elders said bad luck can be on the way when a person is unable to catch fish, especially when other people are catching many. According to one woman:

Something bad is going to happen to your family. They still say that. It's because the fish know, they know what's going to happen.

Another woman said, "When everything is okay, lots of fish come to you."

Respondents related old Eskimo stories about sheefish, suckers, northern pike, and burbot, but none were familiar with any stories featuring whitefish.

The study communities share much in common in the harvest and use of whitefish. For instance, most people fish primarily in spring and fall, most prize whitefish eggs and the harvest of spawning or near-spawning fish, and most have similar methods of processing and preserving the catch. In all the communities, the season of harvest is largely determined by two factors: the availability of quality whitefish and suitable weather conditions for processing and storing the catch. Although modern freezers are now available, few if any households have adequate freezer space to store the large amounts of fish typically harvested. Traditional food preparation techniques—drying, half-drying, aging, fermenting, and freezing—are not only still preferred, but still most practical.

In other ways, the study communities diverge significantly in the harvest and use of whitefish because each community occupies a somewhat different environment and follows somewhat different traditions. For instance, in Noatak and to a lesser extent in Kotzebue men are the primary fishermen, while in Selawik and along the Kobuk River fishing is nearly always the domain of women. The river conditions and spawning grounds near Noatak and in the upper Kobuk make seining the method of choice for harvesting whitefish, while in other communities gillnets are the primary fishing gear. Kotzebue residents employ a unique harvest method for whitefish, digging ditches to capture fish naturally impounded in coastal lagoons. The role of whitefish also varies in each community's overall subsistence activities. Noatak, for instance, focuses far more on trout (Dolly Varden) than on whitefish, while in Selawik whitefish are a central feature of the subsistence harvest. Details of the whitefish fisheries in each community are provided below.

Selawik

In Selawik, whitefish are primarily harvested in spring (late May-June) and fall (late August-September) during their migrations into and out of the lake systems. They are particularly abundant at these times and many can be caught in a short while. One woman

The Subsistence Fishery



Figure 5-1. Map of the Selawik area. Not all fish camps and fishing sites are shown.

explained, "In spring and falltime, it's when you know there are lots. In a little short time you can catch them when they're really running." In addition, spring and fall are the seasons of the year when fish can most easily be processed and stored. Spring is typically drier than fall in the Kotzebue Sound region, and for this reason respondents preferred to do the bulk of their fishing in spring when rain was less likely to spoil racks of drying fish. Selawik is unusual in the region in that it does not have a salmon run, lending a critical importance to the harvest of whitefish and northern pike.

The spring harvest period typically stretches for about three weeks beginning after break-up, usually in late May. Many respondents spend this period at their fish camps which they reach by boat after break-up, catching and drying both northern pike and whitefish. The spring harvest period lasts until warm weather and proliferating insects make it difficult to process fish, usually by late June. The meat of the fish also becomes soft and mushy as the weather and water warm. Because Selawik Lake stays ice-covered longer than other inland bodies of water, the air temperature in Selawik stays cooler later into June than in neighboring areas such as the Kobuk River. "As long as there is ice on the lake, it is cool enough to fish," one respondent said.

Short fishing nets are used right after break-up when the current is fast and ice chunks and driftwood are still floating by. One elder recalled how his mother used to set a short net in spring when only the edges of the river were ice-free. The fresh whitefish obtained at this time was a welcome change from the spring diet of muskrat common in the past.

Gillnet fishing declines in Selawik during the summer months (late June and July) when the weather is too warm for fish to dry without spoiling. Fishing for northern pike and whitefish picks up again in August when the weather cools and insects fade. This is the start of the fall harvest season. Selawik residents again travel by boat to their fish camps to catch and dry whitefish, which begin their seasonal movement between rivers and lakes as fall progresses. Whitefish migrate first, followed by northern pike. The opposite occurs in spring, when pike migrate first, followed by whitefish. One resident said, "In the fall when you start catching lots of pike, you know that the peak of the whitefish run has gone through." The fall fishing period lasts until freeze-up.

Selawik residents also catch whitefish in early winter, at which time the fish are still migrating under the ice. Shortly after freezeup, when the river ice is barely thick enough, Selawik residents set nets under the ice (*sikum ataaqtuq*), usually in the vicinity of the village or within a mile upstream. In November 2002, about 10 to



Figure 5-2. Sunii Jackson, James Ramoth, and Clyde Ramoth check an under-ice net for whitefish near Selawik, November 2002. 12 under-ice nets were set in the Selawik area. These nets varied in length, but were often 100 to 250 feet long. This harvest continues until the ice gets too thick and threatens to freeze in the nets. In most years under-ice net fishing concludes in December, but in the winter of 2001-02 ice conditions allowed fishermen to keep their nets out until the second half of January. One respondent said that in the unusually mild winter of 2000-01 he kept his net out until March. Very cold spells can thicken ice quickly, so fishermen must watch carefully to avoid losing their nets. Nevertheless some nets freeze in each winter and are lost downriver at break-up. Some residents set their under-ice nets right near their houses, diminishing the need for reliable transportation and gas. For households without boats and motors, under-ice fishing provides a good opportunity to harvest a winter's supply of whitefish. Broad whitefish (qalupiaq and *qausriluk*) are the primary species caught in this fishery, along with occasional sheefish, humpback whitefish, and northern pike. Fish caught at this time of year are typically set out individually to



Susan Georgette (2)

freeze, and then stacked outdoors or in a shed to be used as needed through the winter for human food, dog food, community holiday feasts, or in trade. One respondent scaled and cut several broad whitefish each time her net was checked, let the fish drain overnight, and then hung them outside to half-dry in the cold winter air.

To catch whitefish Selawik residents primarily use gillnets with a $3\frac{1}{2}$ - to $4\frac{1}{2}$ -inch stretched mesh. The smaller mesh ($3\frac{1}{2}$ to 4 inches) is used to catch the smaller whitefish, while the 4- to $4\frac{1}{2}$ -inch mesh is used to target the larger broad whitefish. Occasionally 3-inch mesh nets are used to catch least cisco (*anuutituuq* and *qalutchiaq*) and 5-inch mesh nets are used to catch large whitefish and sheefish. One woman uses a 4-inch mesh net when fishing for food for the family, and a 3- or $3\frac{1}{2}$ -inch mesh net when fishing for dog food. The smaller net catches smaller fish but in greater amounts, while the larger net catches the larger fish preferred for human food but in lesser numbers. Another woman uses $3\frac{1}{2}$ -inch mesh nets in spring and 4-inch mesh nets in fall; she said that the larger fish caught by



Figure 5-3. Emma Ramoth's cache of frozen fish caught in nets set under the ice, Selawik, November 2002. These fish, usually baked or eaten as quaq (frozen fish), are shared with others in the village.

the larger mesh are too fat to dry in the spring. Selawik residents typically use nets ranging in length from about 60 to 100 feet. The net length selected depends on the river conditions and on the amount of fish a person wants to catch. Some people set more than one net to obtain enough fish.

Seining is not a common harvest method in Selawik because river conditions are not suitable and whitefish are not gathered in large schools, as they are in spawning areas. The one area with the necessary conditions for seining is the Fish River northeast of Selawik, where a small number of households seine for humpback whitefish (*ikkuiyiq*) in the fall, sometimes as early as August when berries become ripe. One respondent said, "Some people seine, but many people around here don't know how to. You have to have the right place and the right water conditions."

Placing whitefish nets entirely across sloughs or waterways is a widely accepted fishing method in Selawik. "You have to," one woman said, "or the fish slip by." Of the four nets observed by researchers while boating near Selawik in June 2002, two were fully blocking a waterway. This practice takes place primarily in small sloughs or channels infrequently used by boats. It may be more common in the spring than in the fall. During the dark fall nights,



fishermen are concerned their nets will be damaged by boat drivers who fail to see the floats. In addition, in the fall boating activity increases considerably with caribou hunting. For both these reasons, fishermen typically shorten their nets in fall to leave room for boats to get around. One man explained:

When people never pass by, we stretch the net all the way across the slough. But when people are coming and going, especially during hunting time, we leave space for people to get by the net.

In all seasons, however, boat drivers must be alert for nets, slowing down and lifting their motors to cross them if necessary. The length of time that Selawik residents leave their nets across a waterway depends on how many fish they want to catch.

Several respondents pointed out that more than one route often exists to a destination when traveling by boat around Selawik. Fishermen prefer that boats travel in the main channels, allowing them to fish the smaller channels undisturbed. One man said:

Sometimes there are other ways for people to go, but they want to take a shortcut and go by where we're fishing. In Selawik, there is usually more than one way to get someplace.

Another person commented:

Figure 5-4. Emma Ramoth stands in front of her rack of broad whitefish that she cut and hung in winter to make half-dried fish. These fish were caught in underice nets. Selawik, November 2002. So many people have Evinrudes, big Evinrudes. Where we used to catch a lot of fish, we can't put nets there anymore because people think it's their own Evinrude channels when there are other channels where they could go and let us fish in that river.

Respondents also pointed out that these interconnected waterways provide alternate routes for fish to move around, thus preventing fishermen from catching all the fish even when a net entirely blocks a channel.

During the interviews, several respondents mentioned an interesting feature of the Selawik landscape. Circa the 1950s, Selawik residents dug channels through two narrow stretches of land to shorten traveling distances by boat to important subsistence camp areas. One of these, called *Putuniq*, is between Selawik River and the north end of Inland Lake. This channel reportedly eased flooding in the community of Selawik because it allowed a portion of Selawik River water to drain into Inland Lake. A second channel was dug connecting the western end of Inland Lake to *Tuqłumaaġruk* (Tuklomarak River). One resident familiar with the area believes that these channels changed the drainage patterns of the Inland Lake area.

Selawik elders were familiar with the use of fish traps or weirs to catch whitefish. In the past these were placed seasonally in key locations—such as the upper Fish River and small creeks draining lake systems-to trap whitefish running back to the large lakes and main river. In summer or fall people built fences across these waterways with wooden poles and willow brush, and later with chicken wire, to block the downriver movement of whitefish. One respondent said that evidence of these fences is still visible in a slough near her camp. The fences had an opening from which the trapped whitefish were scooped out with large, fine-mesh dip nets. This harvest apparently took place both before and after freeze-up. When people were done fishing, the fences were left open and the ice took them out completely in the spring. Before freeze-up people stored the fish in large pits they dug in the ground, lined with canvas tarps or willows, and then covered with mud to protect the catch from animals. After freeze-up people spilled the fish onto the ice to freeze, divided them into shares, and then stored them on high ground behind their tents. Many of these fish were used for dog food. Fish traps were also used in the *Tuqtumaagruk* (Tuklomarak) area where they were mostly made of willows because spruce poles were not available. An 1884 description of these is included in Burch (1998). Respondents said that fish traps fell into disuse once the community no longer had many sled dogs to feed.

During field work in June 2002, a Selawik resident took re-



searchers to the site of a former fish weir on the Fish River north of the village. The Fish River at this location is clear and fairly shallow with a gravel bottom and occasional stands of spruce along its banks. The fish camp at the weir site was a cleared grassy area amid willows on a cut bank. A homemade barrel stove lay on its side, partially covered in mud, an aluminum roasting pan sat in the grass, and a partially crushed 55-gallon fuel drum stood in a patch of willows near the front of the campsite. An old roll of chicken Figure 5-5. The Fish River north of Selawik, June 2002. This was the site of a fish trap or weir, traditionally built in the fall to harvest migrating whitefish. The Iñupiaq name for Fish River – Ikkuiyiq – also means "humpback whitefish" in Selawik.

wire, likely used to construct the fish trap, lay entwined in the willows. Stored in the willow's upper branches was a weathered dip net frame, absent the net, that was used to scoop out whitefish trapped behind the weir. The net handle attached to the hoop with a mortise and tenon joint, and the hoop and its supports were lashed together with parachute cord. The hoop was semi-oval in shape with about a 4-foot opening on one side. It was an impressive piece of workmanship and a fine example of a traditional fishing tool.



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The Selawik guide explained that the fish camp's occupants were formerly dropped off by boat in the fall with dogs, tents, sleeping bags, and other camp gear, and then returned to the village by dog team after freeze-up. The harvested whitefish were stacked near the willows in piles taller than he was.

Several respondents described fishing sites in the Selawik area as a "first-come, first-served" system. If a fishing spot were not being used, any person was free to use it. One respondent, however, believed that this tradition had changed and that a person now needed to ask permission to place a net near someone's camp, even if the site were not being used. With its many channels and plentiful fish, the Selawik area offered numerous fishing sites, but still a person had to be selective in placing a net if he or she expected to catch fish. Fishermen must be knowledgeable about net placement and familiar with the depth of the water, the width of the river, and the movement of fish. The camps used by Selawik residents for whitefish fishing are scattered throughout the local area with concentra-

Figure 5-6. National Park Service biologist Charlie Lean holds a handmade dip net frame used to scoop whitefish out of a traditional fish trap or weir. The dip net was stored off the ground in willows at a fish camp along the Fish River near Selawik. In the past, fish traps were built here to harvest migrating whitefish (see previous figure). The net frame (opposite) was constructed of lashed mortise and tenon joints, similar to those in a dog sled. June 2002.



tions northeast of Selawik towards Fish River, west of Selawik on the lower Selawik River, and south of Selawik near Inland Lake, *Tuqłumaaġruk*, and Throat River. Families often have more than one camp, using different ones in spring and in fall.

Respondents said that Selawik River and Kobuk River have the same kind of whitefish, but Selawik fish are fatter because they live in muddy water where food is abundant. Kobuk River whitefish also have to contend with a stronger current, making them thinner and



Figure 5-7. Whitefish and northern pike drying on fish racks, Selawik, September 2003. more sinewy than whitefish in Selawik. One man said:

Every kind of whitefish in Selawik is fat. Selawik is almost all water. There's lots of food for whitefish. That's why the whitefish are fat here.

One woman described Kobuk River whitefish as having white meat, while the meat of Selawik whitefish is more yellow. Selawik residents can at times distinguish the origin of whitefish by its taste or by its smell when cooking. "Clearwater" whitefish have a different flavor than "mud water" whitefish. One respondent noted that big whitefish that live far up the Selawik River are skinnier and taste different from the fish near Selawik. They do not have the "muddy taste" because they live in fresher water. "People like to taste each other's fish," one respondent commented. Another said she notices the sex of fish when cutting them, but cannot distinguish between them externally or notice any differences in their taste.

In Selawik, whitefish are typically eaten fresh, dried, half-dried,

or as *quaq* (frozen fish, often aged). A staple Eskimo food, *quaq* requires proper care and temperature to turn out perfectly. One respondent explained:

Take the guts out for *quaq* to age just right. Usually I start making *quaq* in September, maybe around September 15 or 20. You store them in gunnysacks or boxes to age. I use boxes. If you want to get really aged, stinky fish, you cover them with caribou hides or tarps. That's what I learned from an elder. Eat it for stink *quaq*, or in spring have it as *uilaaq* [fermented, frozen, thawed fish]. Stink fish sells for about \$100 per gunnysack. In spring, the fish start to thaw out. When they're partly thawed, it's a delicacy right there. A delicacy!

Residents at times make fish oil by boiling the stomachs, cleaned intestines, and other fat internal organs after first removing the liver and gall bladder. The oil is spooned off the top of the boiled mixture and used like seal oil. Half-dried baked fish eggs are sometimes stored in the oil. Eskimo pudding is made in the fall by crushing ripe cranberries with whitefish eggs, adding a bit of sugar, and stirring until fluffy. Enjoyed by other villages, fish from Selawik are often traded and shared throughout the region. A string of dried Selawik whitefish sells for \$12, and a string of dried pike sells for about \$24. A string is equivalent to eight whitefish or six pike, and a bundle comprises 20 strings of either.

Noorvik

Soon after break-up in late May or early June, Noorvik residents travel to spring camps scattered throughout the delta's lake systems to fish for whitefish. "We usually follow the ice to our camp," a woman explained. Another fisherman said, "We go straight to the lakes to fish for whitefish. If we wait for them here [in the village], we never get them because by then it's time to do something else." One Noorvik resident said she usually starts fishing around June 15. Whitefish caught in the spring are dried for *paniqtuq* (dried fish). This is the preferred season for drying fish because the weather tends to be cool, dry, and breezy and flies are not yet a problem. Noorvik fishermen mostly catch humpback whitefish (*qaalģiq*) in spring, the preferred fish for drying. Broad whitefish (*qausriļuk*) are also caught at this time, but only in small numbers. "They come around, too," one woman said, "but they are slow."

Spring whitefish fishing takes place with gillnets in the sloughs and lakes where fish are found in abundance. It often continues until early July, or until the weather gets too warm to dry fish. Noorvik fishermen then move back to the village from their spring camps, and turn their attention to salmon fishing in the main river.



Figure 5-8. A gillnet for pike and whitefish set across a small channel adjacent to a fish camp, Selawik, June 2002. This was a typical and traditional whitefish set, widely used in spring in the Selawik and Kobuk River areas. Beginning in mid-August residents again fish for whitefish near sloughs along the main river. Fall fishing typically lasts through September, and mostly takes place from the village rather than from fish camps. Broad whitefish are the most abundant species in late fall, and Noorvik residents catch these fat fish to age and freeze for *quaq* (fish eaten frozen). *Amatchiaq* (dried whitefish with roe) are also made in fall, and allowed to age. Least cisco (*qalusraaq*) pass through the area at this time of year, but few people catch them. "If you used a smaller mesh or a seine, you'd get them," an elder said. One woman described her summer's fishing activities:

In springtime, we get all the kinds of whitefish. They all go out from the lakes. *Quptik* [round whitefish] and *qalusraaq* [least cisco] not too much, but a few of them always be in the net. Mostly we get *qaalgiq* [humpback whitefish] and *qausriluk* [broad whitefish]. In springtime we get them for drying. In summer the whitefish go through the rivers and go up. In falltime we also fish for whitefish for frozen fish [*quaq*]. When it's time to freeze around September 15 or 25, we start freezing them. But we don't really fish for



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whitefish during salmon time.

After freeze-up Noorvik residents set nets under the ice for broad and humpback whitefish as soon as the ice is sufficiently thick. Most people who fish under the ice do so for only a short while, although those with a dog team to feed might keep their nets set until November or later. One woman said:

After freeze-up we fish for whitefish under the ice, just for a couple of weeks. We get both *qausriluk* [broad whitefish] and *qaalgiq* [humpback whitefish]. This year we caught a king salmon under the ice. Not a real big one, just right. It was real good. You can get whitefish all winter in the sloughs.

Broad whitefish caught under the ice are especially prized for their eggs. One elder recalled:

When you check net in winter, eggs just come out [of the fish]. We used to mix these eggs together with fresh snow right on the ice, pound them and whip them, and eat them like that. We even eat whitefish eggs with cranberries in the fall. That was our dessert in

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Figure 5-9. Map of the Noorvik area. Not all fish camps and fishing sites are shown.

those days. No goodies, no money then. Life is easy now.

Gillnets are the primary gear used by Noorvik residents to catch whitefish. In spring, smaller "slough" nets are used, often with a stretched mesh size of 3 to 3½ inches. These are typically set from bank to bank in narrow waterways, usually for a period of three weeks or less. "We just get enough for dried fish," a fisherman explained. During an interview one elderly woman said she had been angry when she had learned that regulations prohibited nets from completely blocking streams or sloughs. "We have to fish that way," she said. "Fish go around if we don't. We will go hungry." This regulation has since been changed for federally-managed waters. In fall, nets with larger mesh—usually 4 to 4½ inches—are used to catch the larger broad whitefish. A few residents seine for whitefish,

but this is less common in Noorvik than in the upper Kobuk villages. Gillnet fishing usually takes place downstream from Noorvik, while seining takes place upstream about 2 to 10 miles from the village. Seining was more common in the past when large amounts of fish were needed to sustain dog teams. Two elders explained:

Very few people seine now, but people used to seine. People used to fish all summer because they had dogs to feed. But we don't do that now.

When I was growing up, we never fished in the sloughs. We seined all summer long, five miles upriver at *Kitliqpaa*. We needed lots of fish for dogs. There's hardly any seining now.

Noorvik respondents were familiar with the use of fish traps or weirs, called *sapun*, to catch whitefish, but few had built these themselves. These were constructed after freeze-up in areas between Noorvik and Kiana where the river was neither too wide nor too deep. Spruce trees were cut and placed side-by-side across the river to block the passage of fish. An opening left in the middle of this fence was fitted with a dip net, or *qalu*, that trapped fish. A Noorvik respondent explained:

In falltime, right after it freeze, people used to build a fish trap for whitefish— *qausriluk* [broad whitefish] and *qaalgiq* [humpback whitefish]—near *Aksik*, about 10 miles upriver, where I grew up. That's where the village used to be. The fish trap caught lots of fish and was a lot of fun. People used to share with each other. There was a hole in the ice in front of the net, and when you looked through the hole, you could watch lots of fish going in. They put a split tree on the ground underneath the hole. They used it as a light so you could watch the fish go by. When the net was full, you pulled it out and spilled the fish on the ice. We don't use the *Aksik* camp anymore. But I have a lot of good memories of it.

In Noorvik, whitefish are typically eaten baked, roasted, dried, half-dried, or as *quaq* (frozen fish, often aged). Fish oil was also traditionally rendered from whitefish, sheefish, or any kind of fat fish. "I used to make doughnuts by cooking them outside in fish oil," one elder said. Respondents said that both broad and humpback whitefish are good for drying and good for *quaq*, although most people preferred the fatter broad whitefish for *quaq* and the leaner humpback whitefish for dried fish. One elder said:

The fish are good for *quaq* when we get them from the sloughs. *Qausriluk* [broad whitefish] are fatter than *qaalģiq* [humpback whitefish], and good for *quaq*. The ones that stay in the lakes are fatter than the river ones.

Humpback whitefish are usually scaled before being dried. One woman explained:



Figure 5-10. Map of the upper Kobuk River area. Not all fish camps and fishing sites are shown.

We always scale fish, both whitefish and pike. We let pike sit one day after scaling them before cutting them. That way they dry crunchy, not hard. We hammer them before eating them to make them softer. We scale fish because we like to eat the skin. First you eat the meat, then you cut the skin up in small pieces. It will give you a good chew.

According to respondents, broad whitefish are not routinely scaled because they taste better that way and because their scales are difficult to remove.

Noorvik respondents agreed that whitefish in different areas have different tastes and textures. Selawik whitefish were regarded as fatter than Kobuk delta fish, and having a different smell. "Like a lake," one elder said. Noorvik residents considered their whitefish "richer" than those found in the upper Kobuk area where fish have to work harder to contend with a swift current. One respondent said that whitefish inhabiting clear water are slimier than those inhabiting slow, dark water. The latter are preferred for their flaky meat.



Shungnak and Kobuk

In the upper Kobuk, whitefish are primarily harvested in spring and fall with additional harvests taking place throughout the summer and in early winter. These are the times of year when whitefish are available and in good condition and when the weather is suitable for processing and storing the catch. Whitefish are a staple food in the upper Kobuk communities, as evidenced by a recent harvest survey in Shungnak where 88% of households used whitefish in 2002 and 67% of households harvested this resource (Magdanz, Walker, and Paciorek 2004).

In spring the whitefish harvest begins soon after break-up in May and typically lasts until the weather gets too warm in mid-June. Short gillnets with 3- to 4-inch mesh are set at the mouths of small creeks draining lake systems, such as *Kuutchiaq*, *Saiyuuq*, *Aviļutquġruaq*, *Tayaġaralik*, *Tikiġasrugruk*, *Uqquqłiq*, and *Isruqtauraq*. Other early spring fishing sites include *Kaŋiġaaġruk*, *Umittaq*,



Itnauram Kuvraqtuqvai, and *Sirraqniqruaq*. Broad whitefish (*qausriluk*) and humpback whitefish (*qaalģiq*) are the primary whitefish species caught, along with northern pike, longnose suckers, Arctic grayling, and an occasional trout (Dolly Varden). These are the first fresh fish upper Kobuk residents have had in months, and for this reason the spring fishery is much anticipated. One elder said:

In early spring we used to camp at *Tikiġasrugruk*, and we could catch all kinds of fish in the lakes—*quptik* [round whitefish], *qausriļuk* [broad whitefish], [humpback] whitefish, *siulik* [northern pike], all mixed up. And when the river opened, they start going out the slough. That's the best time to set a net.

The spring harvest is not large in number. Many of the fish caught at this time are freshly baked, roasted, or boiled, with the remainder cut and dried for *paniqtuq* (dried fish). Whoever first sets a net in spring shares the catch with the village, with elders the first recipients. Gillnets set at this time of year often stretch from bank to bank across small creeks. During June field work, researchers


Figure 5-11. Emma Berry and Mildred Black (opposite) check a whitefish gillnet at Kuutchiaq near Shungnak, June 2003. The day's catch included three broad whitefish, one humpback whitefish, and one relatively uncommon Dolly Varden, which Mildred displays (left). Gillnets set in the spring typically catch small numbers of fish compared with seines in the fall – enough to eat fresh with a few left over to dry for paniqtuq (dried fish).

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saw several short nets, about 20 to 35 feet in length, fully blocking small outlets or creeks near Shungnak. These nets are typically fished for only a short period of time.

Whitefish fishing continues at a reduced level in July, when warm weather and insects make it difficult to process and store large quantities of fish. At this time of year, whitefish are often half-dried and stored in freezers. One elder explained:

When we catch *qaalģiq* [humpback whitefish] around July 4th, we have to hang them right away because they spoil easily because it's hot. We don't seine a lot, just catch enough to eat. Enough to eat half-dried. Some people go to camp to seine, but much of the fishing is around the village in early summer.

Another elder said:

In July we start to seine for *qaalġiq* [humpback whitefish]. The first ones to come upriver always be too fat, and they spoil really easy. Later they get skinny and dry better.



Figure 5-12. The late Bessie Custer (left) and Nellie Griest (right) process whitefish along the river in Shungnak, September 2003. Upper Kobuk residents seine large numbers of whitefish in the fall. Families will cut together for days at a time. Fishing for whitefish in July when they are fat is called *tinutraq*. By September whitefish have lost much of this fat. Some upper Kobuk residents prefer the fatter whitefish and are willing to cope with the warm weather of mid-summer to dry them.

Fishing picks up again in August and continues in full swing throughout much of September. The bulk of the whitefish harvest in the upper Kobuk takes place during this August to September season. Whitefish seine nets, called *qaaktuun*, usually 150 feet or



more in length and with 1-inch square mesh, are the primary gear used at this time, and humpback whitefish are the primary whitefish species caught. In a 2002 harvest survey in Shungnak, 88% of the community's total whitefish harvest by weight and 97% of its humpback whitefish harvest were taken with seines (Magdanz et al. 2004). Seining is a particularly efficient harvest technique on spawning grounds such as the upper Kobuk where fish gather in large numbers. Women in the upper Kobuk work long hours cutting Figure 5-13. Nellie Griest (top) finishes cutting a whitefish. Ulus remain the tool of choice. Ella Tickett (bottom) hangs fish to dry on a spruce-pole fish rack. These are primarily humpback whitefish cut for amatchiaq (with roe).



Figure 5-14. Dolly Custer cuts whitefish in an upper Kobuk River fish camp while her son watches. This camp had recently seined more than 1,500 whitefish in one morning. September 2002.

and drying these fish, both as *siraatchiaq* (dried whitefish without eggs) and later in the fall as *amatchiaq* (dried whitefish with eggs). One elder described:

Amatchiaq can be made in late August. The eggs are ready then and the fish can dry if the weather is good. You don't have to wait until September. The eggs get a bit sour or aged when dried in August—real good to eat.

The few broad whitefish (*qausriluk*) caught in the fall are often eaten fresh, but sometimes they are dried. Some people prefer to dry whitefish in August when the fish are not as skinny as in September. Whitefish processing takes place both along the river front in Shungnak and Kobuk and in fish camps above and below the villages.

More than one respondent commented that different seining areas are used in summer than in fall. In September whitefish gather by sandbars where fishermen can seine several times, filling many gunnysacks with fish. One elder said:

In September there are not many *qaalģiq* [humpback whitefish] around Kobuk, but there are lots upriver toward *Maniilaq* [Mauneluk River]. We go fish upriver then. They always say *qaalģiq* go to the strong current when they're ready to spawn. Hardly any are in the eddies then.



A younger fisherman added: "In summer we always go downriver to seine, and in fall we always go upriver to seine. I don't know why this is." In fall when whitefish congregate near sandbars, upper Kobuk fishermen look for bubbles surfacing in the water as a sign of a good seining place; whitefish jump little at this time of year. Different species of whitefish are usually mixed together in the river, but certain seining sites tend to yield more of one species than another.

One elder described several details of seining:

The same places are good for seining every year. You need a beach—any kind, sand or gravel—but not a bank. Some place you can pull the fish in. You need a clean bottom—no sticks. Some seining places are shallow, some deep. There are a lot of good places near the mouth of *Maniilaq* [Mauneluk River]. You need several people to seine. When you seine, you usually have to wait one day until you go back and seine again. Sometimes the fish come right back. But after September 20, when whitefish start moving downriver to spawn, they fill up the eddy right away after you seine. Sometimes you can seine two times in a day. Fish are really moving at that time and go into an eddy to rest on their way downriver.

Whitefish are typically scaled before being cut to dry. Scaling is time-consuming but not difficult, and older children and inexperi-





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Figure 5-15. Beverly Woods (top right) displays humpback whitefish cut and ready to hang on the fish rack to dry (left). The upper Kobuk River was unusually high that week, completely surrounding one rack that had been set up on a sandbar (bottom right). September 2002.



Figure 5-16. The river front at Shungnak on the upper Kobuk River. Several Shungnak families fish from the village, and process their catch under the covered fish racks lining the Kobuk River. September 2002.

enced young women are often assigned this task. A butter knife or a section of a caribou scapula, preferably from a big bull in the fall, are the tools of choice for scaling. Respondents said that whitefish dry more quickly with the scales on, but the meat dries thicker and better with the scales off. In addition, without scales, dried whitefish are easier to tear apart with one's hands, and the skin can be eaten if desired. With good weather, whitefish dry in about three days. Rinsing cut fish well in a clean tub of water before hanging them accelerates the drying process. One elder said:

Fish dry quickly if you wash them good. It gets the slippery stuff off them and they dry quickly.

Upper Kobuk women often string dried whitefish for storage because they take up less space this way. This process was described by a Shungnak woman, Barbara Armstrong, in another recent study on subsistence in the upper Kobuk area (Magdanz 2004):

If the weather is good and breezy, whitefish dry quickly. It is better to string them before they completely dry. When whitefish have dried on a pole for three days (usually), a woman will pile all the fish in one spot, sit down before the pile, take one fish, and remove the backbone. Then she will work on the body part, fold it, *uluk* it [make it pliable], and open it. Using a homemade pick from a caribou horn tine, she will poke a hole in the upper end towards

the tail. Then she will take another fish, fold it, *uluk* it, and repeat until she has strung four fish. She will make two sets of four fish each, then connect the two sets. When done, she will have a string of eight whitefish. Twenty-five strings (*uuyuraatchiat*) make a bundle (*qiliqtat*).

Freeze-up creates a temporary lull in whitefish fishing. In early November, when the river ice is sufficiently thick, Shungnak residents set gillnets with 4- to 5-inch mesh under the ice to catch whitefish. This fishery targets broad whitefish migrating to spawning grounds, and typically lasts about two weeks or so. By this time of year humpback whitefish and least cisco have already spawned and moved to wintering areas, and are only available in small numbers. A 2002 harvest survey in Shungnak showed that broad whitefish comprised 99% of the under-ice whitefish harvest by weight (Magdanz et al. 2004). Fishing for broad whitefish under the ice primarily takes place at *Katyaak*, about 12 river miles below Shungnak. In recent years a handful of under-ice nets, usually no more than five, are tended by Shungnak residents. Broad whitefish caught under the ice are typically set out individually to freeze in the air, and then stacked outdoors or in a shed to be used as needed through the winter. In spring any remaining fish are usually cut and dried, a delicacy to many.

Upper Kobuk elders were familiar with the use of fish traps or weirs in the Kobuk River to catch whitefish, but none of the respondents had participated in building these as adults and some had never seen one. One person commented that fish traps were particularly useful in earlier times when nets had to be made from willow bark. In general, respondents described fences built across the river soon after freeze-up with sharpened spruce trees placed upside down side-by-side to block the passage of fish. In the middle of the fence was an opening, properly aligned with the current, in which a dip net, or *qalu*, was placed. When the net filled with fish, men pulled it up and spilled the fish onto the ice to freeze. These fences were called saputit, and were built after freeze-up for whitefish. A similar type of fish weir called *pauktut* was built before freeze-up for sheefish, and spears rather than dip nets were used to harvest the fish. Typically one fish weir was built for the entire community with the catch divided among community members. In Shungnak a fish weir was often built just above the sandbar upstream from the village. In Kobuk a fish weir was typically built a short distance above the village. Rose Custer, born in the upper Kobuk in 1914, discussed her memories of fish weirs (Magdanz 2004):

Saputit—that's a falltime fishing method, only done after freeze-up.

They cut spruce, and shove them through the hole upside down.



Figure 5-17. To make amatchiaq, humpback whitefish are first scaled (above) then cut (right, top) and hung to dry (right, bottom). Amatchiaq are dried, aged whitefish with roe intact, a highly desired food in the upper Kobuk. Younger or less experienced women typically scale the fish while the older, more experienced women cut them. The brown rock (right, top) is used to sharpen the ulu. September 2002. They call them *qaalģiqsiutit*. When the sheefish go by already, the whitefish will be next to come downriver, after the sheefish. . . . In Shungnak, when Evans Commack was in charge of that weir, I was there. . . . When it freezes early, they will be catching small whitefish for drying. They used a weir called *saputit* for catching whitefish. They used a weir called *pauktut* for sheefish. In a *saputit* weir, they used a dip net. They used a net after making an exit. They used a very small mesh on the dip net.

People will just see [the fish swimming into the dip net]. A person will be watching. When whitefish pass by, people say "*kutraaq*" instead of "*apqusraaq*." After the fish pass by, they will pull the net up, many fish all at once. When they get them out of the water, and spill them on the ice, the top of the ice will be squirming with fish.

One time they were still out [at the weir], even though [the fish] were not coming anymore. They saw something passing by with long hair. That thing just slowly passed by. That's the kind they saw, because they were still at it even though there were no fish [implying, perhaps, they should have quit fishing]. It had long, flowing hair. That was the end of the fish. We don't know what it was.



James Magdanz (3)

Another kind of fish weir was built across small creeks in early summer after least cisco (*qalusraaq*) had entered the lakes, effectively blocking their return to the main river later in fall. At least one respondent had once built a trap like this on a Kobuk River tributary during low water, scooping out least cisco with a dip net. Others recalled their parents constructing these.

In addition to drying, half-drying, and aging, a wide variety of other methods are used by upper Kobuk residents to prepare whitefish. In one favorite dessert—*ittukpalak*—eggs of *qausriluk* (broad whitefish) are mashed with an equal amount of cranberries, then whipped like Eskimo ice cream with one's hand or a fork, and sometimes mixed with sugar or seal oil. This dessert is eaten right away before it loses air and falls. The word *ittukpalak* has also come to mean the color pink. Any kind of fish eggs except those of *quptik* (round whitefish) can be used to make *ittukpalak*. When checking nets in winter, elders used to break open broad whitefish, stir the eggs into fresh snow on the ice, and eat it as a snack.



Whitefish, along with northern pike, were traditionally rendered to make fish oil, which was used similarly to seal oil in coastal communities. One elder explained the process:

My mama would extract oil by boiling whitefish and pike intestines. Not boil it hard, but boil it real slow, then scoop off the oil with a spoon. Let it set. It made real clean oil for *masru* [Eskimo potatoes] or to eat with *paniqtuq* [dried meat or fish]. My mom would fill up three or four large square lard cans with fish oil—maybe three or four gallons. I really like fish oil because I grew up with it. We didn't have much seal oil. When we eat *qaalģiq* [humpback whitefish] stomachs, we boil them and eat them with fish oil. Pike liver with fish oil is real good, too.

Additional details on whitefish harvest techniques and processing in the upper Kobuk River area are available from a number of valuable sources. Anderson et al. (1998) offers illustrations and descriptions on seining, setting nets under the ice, building fish weirs, and cutting and drying whitefish. Giddings (1956, 1961) describes the making of willow bark nets and the construction of fish weirs after freeze-up to intercept migrating whitefish. Burch (1998) presents information on the role of whitefish in the 19th century yearly cycle of upper Kobuk River people and other northwest Alaska Iñupiaq nations.

Noatak

Noatak differs in several ways from the Kobuk River villages and Selawik in its harvest and use of whitefish. Perhaps foremost, whitefish is not as paramount a subsistence food in Noatak as it is in the Selawik and Kobuk River areas. Rather, the fish central to Noatak residents' lives is Dolly Varden, or "trout" as it is locally called, and respondents invariably turned to this topic during interviews for this project. A few respondents said they did not care for whitefish, eating it only if they were hungry.

Located along a swift river near spawning grounds, Noatak has fishing practices in common with the similarly situated upper Kobuk River villages, particularly the predominance of seining as a fall harvest method. As an inland village, Noatak is unusual in that it also shares in a portion of Kotzebue's coastal whitefish harvest pattern because a large segment of the Noatak community traditionally summers along the shores of Kotzebue Sound.

Fall—late August and September—is the primary harvest season for whitefish in Noatak. Much of this harvest occurs in conjunction with seining for trout. Seining nets are characteristically long in length (150 to 200 feet) and small in mesh size (1 square inch). Whitefish and trout are often found mixed together, although



Figure 5-18. Map of the Noatak area. Not all fishing sites are shown.

sometimes one is caught without the other. "Trout come in later than whitefish, just before it freezes, when it starts getting cold," one respondent said. Other fishermen noted that in fall whitefish are moving downriver at the same time trout are moving upriver. Humpback whitefish (*qaalģiq*) is the predominant whitefish species caught by Noatak fishermen.

Most fall seining takes place along the Noatak River between the village and the mouth of *Kuugruaq* (Kugururok River). Specific sites suitable for seining change from year to year. "You can't seine in the same place every year," a respondent said. "When you want to seine, you have to take a trip upriver and find a good spot." One experienced fisherman said he can find whitefish in the river by their smell. Seining trips from Noatak are often multi-day affairs, lasting until a sufficient quantity of fish is obtained. Seining crews typically comprise groups of up to five or six men, sometimes with women accompanying them as cooks and helpers. This contrasts with Selawik and Kobuk River villages where women for the most part are in charge of fishing. Noatak respondents were not certain what accounted for this difference, other than simply "tradition." One man offered the following explanation:

Yes, men seine in Noatak. Where we seine the water is swift and the trout are lively. You have to pull the net quickly or the fish get away. I took women one time, but they weren't quick enough with the net. I'm hollering at them. Next time I don't take them. I can't wait for them to have muscles.

Whitefish fishing takes place to a limited extent in early summer, both in the Noatak River and along the Kotzebue Sound coast near Sisualik. This is the main season for making dried fish (*paniqtuq*). Noatak families at coastal camps set gillnets along the shore for a week or so in June to catch and dry whitefish—primarily humpback whitefish—migrating to and from lakes and coastal lagoons. Families remaining in Noatak who want to dry whitefish seine for them in early July below the village. An elderly man explained:

When whitefish come up Noatak River, people seine these, especially the *qaalģiq* [humpback whitefish]. We get only a few of these *qausiluk* [broad whitefish], very seldom, maybe one or two with lots of other kind. The *qausiluk* come up later, which is probably why we don't get them. In first part of June, people seine like that. They seine down below the village but not as far as the hatchery.

Although prevalent in the past, under-ice fishing for whitefish is not common in contemporary Noatak. A few people engage in this activity from time to time.

Whitefish caught in the fall are usually stored in gunnysacks

to age and freeze for *quaq* (fish eaten frozen). For the most part, Noatak residents do not cut and dry whitefish in the fall to the same extent as Kobuk River and Selawik residents do. Female whitefish are preferred in Noatak because the eggs are prized, and fishermen sometimes release male fish caught in the seine. One man said:

People around here really go for the eggs, and like to eat them with seal oil. Even kids eat the eggs fresh. People like to bust the fish open and eat them fresh like that. Kobuk River has big whitefish with big eggs. Our fish [humpback whitefish] have small eggs—the perfect size for eating like that. We don't like those big eggs.

Noatak residents time their fall fishing to result in properly aged whitefish, which will later be eaten as frozen fish (*quaq*). One respondent offered this description:

I time my fishing to age the fish. I put some away, then a week later I put more away, and then a week later I put more. Then you can try them, and some might be too strong and you find which ones are just right. I put them away just when it's starting to freeze. Right after it freezes, then it gets warm again and that's when the fish start aging. You can put the fish in the freezer, but then it doesn't age. We like our fish aged.

Gillnets are not widely used in Noatak to catch whitefish, except along the coast and in the Noatak flats area. One fisherman said:

You can catch whitefish in gillnets but no one really does. You have to pick each fish out of the net. It's more work. Seining is easier.

Gillnets were used more widely in the past when some Noatak families spent break-up in camps on the Noatak flats, fishing and hunting muskrat and waterfowl. Nets were often set bank to bank across the outlets of lakes and the mouths of creeks and sloughs. Spring camping on the flats is not as common as it once was. One elder explained:

When the ice leaves, we used to use 3½-inch mesh nets. We used to be camping down on the flats, hunting muskrats. We had dogs. Now our kids don't do that. We caught *qaalģiq* [humpback whitefish] and pike in nets along *Sivisuuq* [Sevisok] where we used to camp. We used to put nets across the creek flowing into *Sivisuuq*.

As in other villages, Noatak respondents were familiar with the use of fish traps or weirs to catch migrating fish in late fall, but few if any had constructed these as adults. One elder explained:

People used to build fish traps in the river after freeze-up. Our parents made them, but we've never made them. We'd walk over and check their traps when we were young, pulling a little sled. The traps would catch all mix of fish—mudshark, trout, grayling, and whitefish. People would block the stream with straight, thin, reddish willows in a V-shape that let the water go through but not the fish. There would be a hoop at the opening in the willow fence

and sharpened sticks put in a funnel shape to keep the fish from going out. They'd make a wire mesh net about eight feet long. You could untie the wire mesh net from the hoop and lift it out. We called it *taluyaq*. There would be current where the fish were going down, and the opening to the trap narrowed so the fish can't turn around. Sometimes it would get so full of fish the trap would burst. When the river starts freezing to the bottom in places, fish start moving around.

Another elder described fish weirs that were constructed in fall, but not checked for fish until after freeze-up:

Creeks around here—you can block them. When the leaves go down, you block them. When you can travel on top of the ice, you go open it. The fish are going out. You can pile up any much fish that you want. Long ago people did that. They didn't have motors to run around with or seining nets.

Among other places, this type of fish trap was built in the creek draining *Narvaġruk* (Lake Narvakrak) near the upper Noatak canyons where both broad and humpback whitefish were available in abundance. An elder offered the following piece of survival knowledge:

My dad tell me that if I'm going to starve, walk to that lake and block it just before it freeze up. You could pile how many sled loads from that lake. I've never done that, but it's something people did a long time ago.

Another traditional location for fish traps or weirs was in creeks draining into *Aliiqtugnaq* (Aliktongnak Lake) on the Noatak flats.

Kotzebue

As a regional center, Kotzebue presents a more diverse pattern in its harvest and use of whitefish than the smaller villages. Kotzebue residents harvest whitefish from a large geographic area and from a wide variety of habitats, including the Noatak flats, lower Noatak River drainage, ocean beaches, and coastal lagoons. The most significant fishery for whitefish in the Kotzebue area takes place at *Anigaaq*, the outlet to Krusenstern Lagoon, located about 22 miles northwest of Kotzebue. This fishery is unusual, if not unique, in that it involves digging ditches or trenches in beach gravel to harvest whitefish entrapped in a lagoon system. Although neither as common nor as critical as it once was, this fishing technique continues today. It is a simple and ingenious way to harvest a large volume of fish, especially in earlier years when gillnets were hard to make and quick to wear out.

The Anigaaq whitefish fishery is made possible by a set of natu-

ral circumstances that lead to the creation of what is essentially an enormous fish trap. The waterways of the Krusenstern area include a large, brackish lagoon; many lakes and ponds; several channels connecting these; and freshwater creeks draining nearby hills. This complex of waterways empties into the ocean through a single mouth at Anigaaq. In spring, high water from ice and snow melt keeps this outlet fairly wide and deep, easy to negotiate with a boat and difficult to cross without one. With the retreat of the sea ice in summer, the coast is subjected to increased wave action which transports gravel along the shore and gradually closes in the outlet until it is completely dammed. Thousands of whitefish that entered the lagoon system to feed after break-up find themselves trapped behind the dammed outlet. As fall approaches, egg-laden whitefish eager to leave the lagoon for their spawning grounds crowd near the mouth, seeking an avenue for escape. It is at this point that the Anigaaq whitefish fishery occurs.

To harvest these whitefish, fishermen dig ditches in the porous beach gravel from the edge of the blocked outlet towards the ocean. The Iñupiaq term for this ditch or trench is *qargisaq* (plural, *qargi*sat). The grade of the *qargisaq* must be such that water flows steadily at its entrance but seeps into the gravel at its end. This current draws whitefish out of the lagoon and into the ditch, at the end of which they run out of water and flop on the beach. Fishermen then simply gather up the fish with their hands and place them in gunnysacks. No nets are used, and no elaborate fish traps are constructed. This ditch technique works because the gravel blocking the outlet functions as a dam, raising the water level in the lagoon higher than the ocean level. "You really notice it when the tide is low," one elder observed. The difference in water level creates a strong flow underneath the coarse beach gravel at the outlet, especially during a north wind when the ocean is particularly low. Whitefish sense this flow as the route out of the lagoon, spurring them first to gather at the outlet and then to follow the current into the ditches. The productivity of a gargisaq depends on the strength of its current and therefore varies with the ocean level. One respondent said:

At very high water on the ocean, there's maybe just a very little trickle running down [the *qargisaq*]. On the other hand, when the ocean drops two or three feet or so, why, you got a real stream running out there.

To be effective, a *qargisaq* needs not only the correct downhill grade but also the proper size of gravel. One Kotzebue respondent explained:

We dug trenches when it started cooling off, usually in September, and we fished the trenches until it snowed. Then you got your dogs



Figure 5-19. An aerial view of Anigaaq in fall. Summer storms build a gravel beach across the outlet to the Krusenstern Lagoon system, blocking the channel. Water percolates through the porous gravel, but fish are unable to pass. In early summer, the channel empties directly into the ocean near the center of this picture. Note the two ditches evident near the lower portion of the channel. September 2003. and went to town. It's kind of interesting—the gravel's not all the same at *Anigaaq*. You have to dig down a little bit and check the gravel. You need bigger gravel. Some of it's sand, you know. The water won't soak into the sand. You have to put the trench in the right place. You can dig trenches even when there's ice on top [of the outlet].

A *qargisaq* must also be dug at the proper time. If made too early, only sticklebacks will be caught, according to one respondent. Least cisco (*iqalusaaq*) are typically the first whitefish available in a *qargisaq*. These are relatively easy to catch, even as early as the beginning of September.

In past years *Anigaaq* was a major fall camp with 8 to 10 extended families usually camped there for two or more months. Harvesting a winter's supply of whitefish for both human food and dog food was the primary reason for people being there. Typically each family had its own ditch, and some might have two, although occasionally everyone worked together on one long *qargisaq*. The



location of each family's *qargisaq* was not fixed, but was determined each fall on a first-come basis. By starting to dig a *qargisaq* or by placing an old gas can or log to signal an intention to do so, a person could claim a site. The two edges of the dammed outlet were often choice locations. Kotzebue elders offered these two observations:

There's no limit in the number [of *qargisat*] you can have. The thing is quite wide down there. There is some jockeying always for the best site. The best site is determined by how strong you can get the current to the mouth of your ditch. And that, of course, is determined by what kind of gravel you got. You have no way of telling. It's just a matter of trial and error. But some *qargisat* would run a lot more of a steady current than others. And that would be the one that would attract fish.

When I was young, each family at *Anigaaq* had their own trench. There would be quite a few trenches. My family's trench was typically at the [western] end, but I wouldn't say each family had a designated space. My grandfather used to not get that many fish early, but then late in the season he would get a lot. Figure 5-20. Sam Williams waits patiently by his ditch, or qargisaq, to catch whitefish. A few whitefish can be seen splashing in the ditch. Until recently, several ditches were maintained each fall at Anigaaq, the site of Kotzebue's major fall whitefish fishery. In the past, longer ditches were built, often with a big pool at the end. September 2003.



Figure 5-21. Map of the Kotzebue Area. Not all fishing sites are shown.



James Magdanz

The whitefish fishery at *Anigaaq* was critically important to the families who traditionally occupied the Sealing Point (Cape Krusenstern) and Sisualik areas. These families followed a seasonal pattern in which they spent April through early July hunting seals at Sealing Point; moved east along the coast to Sisualik in early July to catch and dry salmon; moved west again to *Anigaaq* in late August to fish for whitefish; and in November or December moved to Kotzebue or a protected timbered area for the winter. The best time for harvesting whitefish at *Anigaaq* was in September and October before ice became a problem. However, a *qargisaq* could be maintained into early December if necessary. One elder said:

We sometimes quit fishing in November. When this area freeze, we quit. We quit because the fish got no eggs. When you got no dogs, you can't use those fish [without eggs] no more. We used to keep it open until December in early years when we had dogs. At that time fishing gets real slow because there's not much fish left over. We get them already in August, September, October. Boy, there's lots of fish in those days! We used to have lots of fish.

A *qargisaq* requires a considerable amount of work and frequent tending to maintain a steady flow of water. At the top of the ditch,

Figure 5-22. Map of the Anigaaq area. Not all camps and fishing sites are shown.



fishermen often build a katagiaq or drop-off, often with a board on edge, so that fish coming into the ditch cannot easily get out again. In stormy weather, ocean swells cover ditches with gravel, necessitating their complete re-digging. The researchers watched a Kotzebue elder maintain a small *qargisaq* on a September afternoon in 2003. He sat by the ditch with a shovel, periodically lifting shovelfuls of small fish-mostly sticklebacks along with small flounders and sculpins—onto the beach. If not removed, these small fish plug the gravel, causing the water to pool rather than to drain. Gulls, which congregate near the outlet for an easy meal, quickly clean up these discarded fish. The elder occasionally pushed the shovel blade into the gravel at the end of the ditch, and wiggled it back and forth to encourage the water to drain. He waited by the ditch from early afternoon until the sky began to grow dark around 9:30 in the evening. He had caught five humpback whitefish—a small catch—by the time he left, and planned to return in the morning.

Because of the importance of this fishery, strict rules were for-



merly in place to guide the fishery and to help insure its success. For instance, elders forbid children to run or pound on the outlet ice because it frightened whitefish away from the mouth and back into the lagoon system. Similarly, lights, noise, and even standing by the outlet were not permitted so as not to scare away fish. People had to crouch as they moved so the fish would not mistake them for a bear. Gillnets could not be set within a certain distance of the mouth. Seining near the mouth was not tolerated, except perhaps early in the fall before ditches were being fished. On windy days people residing in the area sometimes gave others permission to seine because they knew fish would not go into the qargisat under those conditions; seining was attractive to people living in Kotzebue who wanted to obtain a large amount of fish in a short while. In recent decades, local families worried that someone unfamiliar with the fishery might open the outlet to get a boat through, and inadvertently allow the whitefish to escape.

The predominant whitefish species caught at Anigaaq is hump-

Figure 5-23. A gillnet set for whitefish at Anigaaq, September 2003. Gillnets have become more common in this area in recent years, as the use of qargisat, or ditches, has slowly diminished. This change is driven in part by a decreased demand for whitefish for dog food and by the ready availability of durable nylon nets.



Figure 5-24. Thomas Williams (right), assisted by National Park Service biologist Charlie Lean (left), pulls out a whitefish gillnet at Anigaaq after an afternoon of fishing on a windy fall day. The net was set all the way across the channel for a few hours, and caught about 75 fish, mostly humpback whitefish. September 2003. back whitefish (*qaalģiq*). Least cisco (*iqalusaaq*) are also caught, along with the relatively rare broad whitefish (*qausiļuk* or *sigguiļaq*) and Bering cisco (*tipuk*). *Anigaaq* whitefish are not normally dried, but stored to age and freeze for quaq (fish eaten frozen) or to use for dog food. "They're a little too fat for *paniqtuq* [dried fish]," a respondent said. Another elder explained:

The consistent thing [about all the lagoon fisheries] is being able to get the whitefish at the right time. Right after temperatures get cool enough so that you don't have a fly problem but it still will be awhile before the sack will freeze solid so it does gain an aged taste. And that's when people would fish these, when your first frosts, first real ice begins to form. Fish them quickly, sack up what you get. That would be your catch.

In the past, whitefish harvested from the ditches were stored in grass-lined holes in the permafrost along the bluff above *Anigaaq*. One man recalled:

I remember my grandfather putting fish in a cache on the hill



[above *Anigaaq*]. He'd cover it with grass. In spring the fish would get really ripe. We'd take the scales off and just eat them. Most of the whitefish stored like that were for dogs, but people used them, too.

Another elder talked about the use of these caches for storing whitefish:

At *Anigaaq* whitefish would be put up there [in holes along the bluff] for dog feed because they're just about number one dog feed. When you open a hole of that kind in November, say, or even in December, they're still thawed. They don't freeze in there. They're just like a can of sardines. They're still soft when you first open them which is another advantage for dog feed. There are some exceptions, I guess. People eat once in awhile from those [caches] that are up there on top of the hill. But primarily they're made for dog feed use. If it does turn out that they don't seem to be quite too strong, why, they certainly would be good for human use. Especially *iqalusaaq* [least cisco] with the big eggs.

If the outlet at Anigaaq closes early-before the first of Au-





Figure 5-25. Thomas Williams ties up a gunnysack of whitefish caught in his gillnet (top). A full gunnysack weighs 100 pounds or more. Charlie Lean helps Thomas lash the gunnysack to a "fourwheeler," or all-terrain vehicle, to transport back to camp (bottom).



Figure 5-26. Bob Uhl picks whitefish from his gillnet at Anigaaq, September 2003. That day he caught about 50 humpback whitefish, 2 broad whitefish, and many small flounders.



gust—large numbers of whitefish are still feeding in the lagoon system and become trapped. If the outlet closes late—in late August or September—whitefish have already begun to leave the lagoon and fewer will be available. In 2003 the outlet closed unusually early, soon after July 4, and many fish were trapped. In 2002 the outlet closed unusually late, near the end of August, and the result was one of the poorest whitefish years in memory. Occasionally the outlet closes early but is later opened by a storm, allowing the fish to escape. One fisherman explained:

Once in awhile *Anigaaq* busts open in the fall, and then there are no fish. Or if it closes too late there won't be any fish. I can't tell you how often this happens. In the old days when that happened, people wouldn't go there to camp. If it closes by early August or the latter part of July, there will usually be fish. The ocean swells usually close it. It's interesting—when there's a big storm at *Anigaaq* and the waves are washing over the beach the whitefish will swim out. Figure 5-27. Carrie Uhl (right) scales whitefish at her camp at Sisualik, while Thomas Williams (left) scales a sheefish. When the outlet closes early, sheefish are trapped in the Krusenstern Lagoon system along with whitefish. A Bering cisco is visible on the table in the foreground. September 2003.

If the outlet closes late, fishermen are uncertain about the number of fish remaining in the lagoon system. This was a significant concern in the past when moving to that location committed a family to spending the fall there. If an insufficient amount of fish turned out to be available, the family faced a serious food shortage. This was especially true in the era when caribou were not available in the region. One elder explained:

It's always a guess as to how many fish are trapped in there. And there have been years when there were very few fish and that means a starvation situation. . . . But a whole lot of that picture builds up from a time prior to when there were caribou available. They haven't been there all the time. Without caribou in the country, and with only small game, ptarmigan, *ukpik* [snowy owl], and stuff like that available, you get along pretty well keeping your family fed but your problem of feeding your dogs would get extreme. Nobody likes to be short of dog feed and family food. And that's what it would amount to because you've committed yourself and it's too late in the season to recoup generally. You can't move back up to Noatak or somewhere once you've moved yourself to this area. You couldn't in those days. You could nowadays.

The movement of whitefish along the coast at Sisualik in later summer is one indicator of the number of fish likely remaining in the Krusenstern Lagoon system. Whitefish pass by Sisualik on the high water of June, heading west to feeding grounds in the coastal lagoons. By July 4 this run of whitefish has essentially ended. Beginning in mid-July, Sisualik fishermen keep an eye out for whitefish moving east along the coast back towards the Noatak River. These fish are fat from feeding, unlike the lean, westbound ones netted earlier in summer. The extent to which these fat, eastbound fish are caught provides fishermen with some clue as to the number of fish remaining at *Anigaaq*. If the lagoon outlets are closed, only stray whitefish are caught at Sisualik. If *Anigaaq* is breached in later summer, Sisualik fishermen set all the nets they can and catch as many whitefish as possible during the three or four days the fish pass by.

In the past ten years or so, the use of *qargisat* has diminished but not disappeared. Nowadays gillnets are more commonly used, usually with 3- to 3¹/₂-inch mesh. The shift to nets has been driven in part by the ready availability of durable nylon nets and by a declining need for whitefish for dog food. The *Anigaaq* site nevertheless remains a vital location for whitefish fishing and for other subsistence activities. The site continues to be used primarily by families who traditionally occupied this territory, although other Kotzebue residents occasionally set nets for whitefish during brief trips to *Anigaaq*. When asked about use of this area by other than

Sealing Point families, one elder said:

They do, just go over [for the day], not staying there. Just pick some fish, whatever they need. And sometimes we even don't know who gets fish and we always hear later that they just put in a net and take off again. It's free for all, anybody that wants to fish when there's some fish. They say it's free for all, those old people what we raise with.

Other lagoon systems along the coast north of Kotzebue also trap whitefish when the outlets close early enough, producing productive fall fisheries at least in some years. Among these are *Akulaaq*, the lagoon just east of *Anigaaq*; and *Qiliqmiaq* (Kiligmak Inlet), the next major lagoon to the north. Neither are as large nor as reliable as *Anigaaq*, but they offer alternatives and variety. The kinds of whitefish available in each lagoon vary from year to year depending on when the outlets close. Several respondents had previously set nets at *Qiliqmiaq*, known for having bigger and fatter fish and more Bering cisco (*tipuk*) than *Anigaaq*. One elder described fishing in this area:

We use only nets in that *Qiliqmiaq* area, just nets. I believe in early years they used to have those *qargisat* [ditches], too, but I've never seen any. I've gone over there and traveled that area. I've never seen anybody living there in falltime.

Other respondents spoke about changes at *Akulaaq*, which had once been a reliably productive fishery. Several respondents commented that the outlet to *Akulaaq* had not opened in the past two years, preventing fish from entering or leaving. Two elders offered the following observations:

Akulaaq has sure changed over the years. It's one of the places where we used to camp in falltime. We used to catch a lot of fish there. The mouth used to be close to the grave, and now it's at the other end. Some years it doesn't open at all. It's not very deep. Whitefish in there in winter would probably freeze.

Akulaaq was as regular as Anigaaq up until five years ago, maybe eight years ago. It was as regular as Anigaaq in opening and closing. It's just in this last eight or ten years it started to either stay closed or stay open. When it was less erratic in what it did, you could pretty much depend on it having a good lot of fish if Anigaaq had a good lot of fish. But there is a difference. There was often a difference in the size of the fish. Akulaaq has a reputation for having smaller tipuk, and even smaller humpback whitefish.

Lagoons on the Baldwin Peninsula also trap whitefish in some years. Two of these are along the coast south of Kotzebue: Riley Wreck and *Igluġruat*, the lagoon between Riley Wreck and Cape Blossom. Two others are on the west side of Kobuk Lake: *Akłaq*

and a lagoon of unknown name near *Ninŋuq* (Nimiuk Point). One elder described his fishing experience at this latter site:

I once went with my father and three brothers to the lagoon just north of *Ninŋuq* [Nimiuk Point]. After freeze-up, we went back to that lake there, made a hole right there to make a current to Kobuk Lake. It was like a little chute. We had a great big dip net, and when we filled it up, we would block the chute with a board, and spill the fish on the ice. The fish would flop then freeze really clean. We got two sled loads. They were whitefish—kind of long ones, but good eating. People used to do that.

In spring Kotzebue residents set gillnets for whitefish south of town towards Sadie Creek. One resident sets a net along the beach below Kotzebue to catch humpback whitefish as soon as the shore is ice-free. Some of these fish are fat, he said, but many are skinny and good for making dried fish. The lower Noatak River up to Eli River is also used by Kotzebue residents for setting whitefish gillnets in spring and fall. The *Sivisuuq* (Sevisok) area with its many lakes and streams is particularly productive for broad and humpback whitefish and least cisco. One respondent said:

I usually use a 5-inch mesh net at *Sivisuuq*. Sometimes a 3-inch one for *iqalusaaq* [least cisco]. We want the big ones, though. We only fish in the falltime at *Sivisuuq*, both for *quaq* [frozen fish, often aged] and for dog food. We fish at the end of September or early October. Not under the ice, just before freeze-up. We fish at the mouth of *Sivisuuq*. We don't fish under the ice—not many whitefish then, although we can get graylings anywhere.

Residents of several year-round camps located along the north shore of Kobuk Lake seasonally set whitefish nets. Humpback whitefish is the most common whitefish species caught in this area, along with least cisco if a small-mesh net is used. One respondent catches egg-laden broad whitefish with a 5-inch mesh net under the ice in late fall. Fishermen typically pull out small-mesh whitefish nets by early December and replace them with large-mesh nets for sheefish.

In June Kotzebue families camped at Sisualik catch whitefish with gillnets as the fish pass by along the shore. One Sisualik fisherman uses a net with 3³/4-inch mesh at this time. He formerly used a smaller net with 3- or 3¹/4-inch mesh, but caught too many fish and preferred to target the bigger ones. Fish caught at this time of year are lean, and good for *paniqtuq* (dried fish). "Spring is the time to cut and dry whitefish," one elder remarked.



Harvest Estimates

Estimates of the quantity of whitefish harvested are available for some communities in the Kotzebue Sound region. These estimates come from previous research projects, including comprehensive baseline surveys of subsistence harvests and annual surveys of subsistence harvests of salmon and other fish. Most of these surveys were the work of the Division of Subsistence, Alaska Department of Fish and Game, often in cooperation with Maniilaq Association or village tribal councils. Although documenting harvest quantities was not a goal of the current project, the information is included here because of its likely value to resource managers and other readers.

Between 1997 and 2003, whitefish harvests in the combined Kobuk River villages (Noorvik, Kiana, Ambler, Shungnak, and Kobuk) and Noatak have ranged from an estimated 39,754 to 84,851 fish (Georgette, Caylor, and Trigg 2004) (Fig. 5-28). Harvests by village by year are presented in Table 5-1. These annual estimates are derived from subsistence salmon harvest surveys conducted house-to-house, which include questions on the harvest of sheefish, whitefish, and trout (Dolly Varden). Comparable harvest data are not available for Selawik. Because salmon are generally not found

Figure 5-28. Estimated harvests of whitefish, 1997-2003. Estimated total harvests of whitefish for the five Kobuk River villages and Noatak ranged from about 40,000 fish in 1998 to 85,000 fish in 1997. Harvest estimates in 2001 and 2002 were incomplete. The 2001 estimate does not include Ambler. The 2002 estimate includes only Noorvik and Noatak. Selawik and Kotzebue are not included in any of these estimates.

	Ambler	Kiana	Kobuk	Noatak	Noorvik	Shungnak	Total
1997							
Number of Households	83	108	26	84	124	57	482
Estimated Number of Whitefish	15,052	21,877	1,420	2,363	30,938	13,201	84,851
1998							
Number of Households	80	102	25	97	129	56	489
Estimated Number of Whitefish	3,326	5,188	1,115	4,320	16,677	9,128	39,754
1999							
Number of Households	71	91	23	91	118	51	445
Estimated Number of Whitefish	8,170	5,464	871	1,375	30,809	9,637	56,326
2000							
Number of Households	70	88	30	102	112	46	448
Estimated Number of Whitefish	35,118	8,867	805	2,664	15,621	7,023	70,097
2001							
Number of Households	-	87	26	96	108	46	363
Estimated Number of Whitefish	NA	7,118	0	2,443	14,711	6,705	30,976
2002							
Number of Households	-	-	-	101	115	-	216
Estimated Number of Whitefish	NA	NA	NA	2,919	22,688	NA	25,607
2003							
Number of Households	67	95	34	104	138	50	488
Estimated Number of Whitefish	14,348	10,899	9,257	4,387	16,175	18,175	73,242

TABLE 5-1. COMMUNITY HARVEST SURVEY ESTIMATES, 1997-2003.

in Selawik, this community has not been part of the annual harvest survey effort. With a heavy dependence on whitefish, Selawik's harvest of this resource is likely substantial. Limited data from the mid-1980s for only the spring fishery indicated a harvest of 10,000 to 20,000 whitefish in Selawik (Johnson 1986).

Baseline surveys provide a more detailed look at whitefish harvests. These comprehensive surveys of all resources collect information on whitefish harvests by species, unlike the abbreviated annual salmon harvest surveys. A baseline survey conducted in Shungnak in 2002 showed that whitefish accounted for 31% of the community's wild food harvest by weight—more than twice the contribution of salmon and almost as much as caribou (Magdanz et al. 2004) (Fig. 5-29). This is strong quantitative evidence of the significance of whitefish in the upper Kobuk River communities. Humpback whitefish accounted for the overwhelming majority of Shungnak's whitefish harvest. The total estimated whitefish harvest in Shungnak was 21,625 fish, including 19,340 humpback whitefish (89%), 1,744 broad whitefish (8%), 428 least cisco (2%), 108 round whitefish (0.5%), and 5 unknown whitefish (<0.1%).

A baseline subsistence harvest survey conducted in Noatak in



1994 showed whitefish accounting for about 3% of Noatak's wild food harvest by weight, a significantly smaller proportion than in Shungnak (Fig. 5-29). In comparison, salmon accounted for 26% of Noatak's harvest by weight, and char for 9% (Alaska Department of Fish and Game 2001a). As in Shungnak, humpback whitefish comprised the majority of Noatak's whitefish harvest. The total estimated whitefish harvest in Noatak was 2,504 fish, including 1,684 humpback whitefish (67%), 189 Bering cisco (8%), 189 round Figure 5-29. Estimated subsistence harvests, Shungnak, 2002 (top) and Noatak, 1994 (bottom). Whitefish accounted for a larger proportion of the total harvest of wild food (by weight) in Shungnak than in Noatak.

The Subsistence Fishery

whitefish (8%), 62 least cisco (2%), 23 broad whitefish (1%), and 357 unknown whitefish (14%). During the study year, whitefish were used by 44% of Noatak households and harvested by 34% of households. The smaller role of whitefish in Noatak than in the upper Kobuk villages was confirmed by the narrative information collected in the current study.

6 Discussion

The 57 respondents in this study provided a remarkable body of Iñupiaq traditional knowledge pertaining to the natural history of whitefish, some of which has not been previously documented. The interview material confirmed the importance of whitefish as a central subsistence resource in the Kotzebue Sound region, particularly in Selawik and the Kobuk River villages, but also in the other study communities of Noatak and Kotzebue. Whitefish have proven to be a consistently abundant and highly reliable food source over the lifetimes of respondents, and quite likely for generations before that. In many parts of the region, whitefish have played a critical role in seeing people through years of failed salmon runs, diminished caribou herds, and other resource shortages.

Additional documentation of the Iñupiaq taxonomy of whitefish was one of the highlights of the project results. While other studies have listed Iñupiaq names for whitefish species, few have discussed the distinctions between the species or compiled this information on a village-by-village basis. This information helps bridge traditional knowledge with scientific knowledge by illuminating the different terminology used by biologists and Iñupiaq fishermen to describe whitefish. The study did not resolve all the questions about the Iñupiaq naming system for whitefish, but it did build a solid foundation of knowledge that can be revised and refined in the future.

Of particular interest was the complexity of Iñupiaq whitefish taxonomy in Selawik. In this village, residents recognize at least two species each of broad whitefish, humpback whitefish, and least cisco whereas western science recognizes one. This contrasted with the other study communities where the Iñupiaq classification of whitefish appeared to be largely congruent with the western classification system. Without a salmon run, Selawik focuses its fishing effort on whitefish and pike, leading researchers to speculate that this might account for Selawik residents developing a particularly discriminating approach to whitefish. The complexity of Iñupiaq whitefish taxonomy in Selawik might also be related to the unusual occurrence of whitefish juveniles, mature spawners, and mature non-spawners all inhabiting the Selawik River delta concurrently

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(Brown 2004). It might be the case, for instance, that an *ikkuiyiq* is a mature spawning humpback whitefish and a *qaalġiq* is a mature non-spawning humpback whitefish, though this is purely conjecture on the part of the researchers.

This study also contributed interesting details on the range of whitefish species in the Kotzebue Sound region. Existing range information tends to be very general, in most cases covering the entire state of Alaska. The range of least cisco, for instance, is shown as including the entire Kotzebue Sound region as well as all of northern and western Alaska (Mecklenburg et al. 2002; Morrow 1980). However, Shungnak respondents described the upriver range of least cisco on the Kobuk River to end somewhere between Ambler and Qala. Range maps in Mecklenburg et al. (2002) depict none of the species in the humpback whitefish complex to occur along the inland reaches of the Selawik, Kobuk, or Noatak rivers, although key respondent interviews and researchers' first-hand observations confirm that humpback whitefish are indeed one of the most common whitefish species in these watersheds. Respondents also contributed other useful details on whitefish range and abundance in the Kotzebue Sound region: broad whitefish are relatively uncommon in the Anigaaq area and in the Noatak River above the Noatak flats; Bering cisco are found only in coastal areas, and not in delta areas; and round whitefish are unavailable in coastal areas and the Selawik River delta, but relatively common in the upper Kobuk and Noatak rivers.

Other highlights of the research relating to the natural history of whitefish include the following:

- Respondents identified several general whitefish spawning areas, although the precise boundaries of these were not determined. Spawning areas described include the upper Kobuk River; the Noatak River between the village of Noatak and *Kuugruaq* (Kugururok River); the upper Fish River and *Siŋiaġruk* (Singauruk River) near Selawik; and the upper Selawik River. In the scientific literature, very few spawning areas for any whitefish species have been documented in the Kotzebue Sound region, and none have been documented in the region for broad whitefish. Shungnak residents, however, are familiar with broad whitefish spawning under the ice in early November in nearby areas. This merits further scientific investigation.
- No respondents had any information on the timing or location of Bering cisco spawning. The scientific community likewise

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has little information on the spawning habits of Bering cisco in the Kotzebue Sound region. Scientists generally believe that Bering cisco spawn in the Yukon River system, even those from as far away as Barrow (Bickham et al. 1997). Further scientific research could shed light on this question.

- Specific important habitat sites for whitefish include *Narvaġruk* (Lake Narvakrak) on the north side of the upper Noatak canyons and *Tuksruk* (Situkuyok River) in the Cape Krusenstern area. *Narvaġruk* was identified by Noatak respondents as an important summering area for whitefish. Broad whitefish, uncommon above the village of Noatak, inhabit this lake at least seasonally in significant numbers. Kotzebue residents described a specific location along *Tuksruk* where in some years a dense concentration of whitefish can be found in winter, presumably attracted by oxygenated water. This especially occurs in years when large numbers of whitefish are trapped at *Anigaaq*. Whitefish also have been observed spawning here in late fall.
- The seasonal movements of whitefish are complex, with fish even of the same species following different movement patterns. Many respondents described a movement of whitefish out of lakes in June, but whether these fish overwinter in the lakes or move in with spring high water is not entirely clear. Both perhaps occur. Other whitefish move into lakes in early summer to feed, moving out of them later in summer to spawn. Some fish remain resident in upriver areas all year, while others return to delta areas in late fall to overwinter. Food availability likely drives a significant portion of this movement.
- Respondents in the Kobuk River communities distinguished between "lake" whitefish and "river" whitefish by the stomach contents and by the flavor and color of the meat. These differences possibly indicate whether or not a fish is spawning that year. Scientists believe that broad and humpback whitefish are alternate-year spawners, meaning that individual fish spawn only every other year. They also believe that whitefish preparing to spawn do not usually feed, although the latter did not prove to be true for broad whitefish or least cisco in recent research on the lower Selawik River (Brown 2004). The movement of whitefish in general and the significance of the characteristics of "lake" and "river"

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whitefish are topics deserving further scientific inquiry.

In addition to whitefish natural history, the key respondent interviews covered topics pertaining to the subsistence harvest and use of whitefish. Several previous studies in the region present excellent information on aspects of whitefish subsistence use, including Anderson et al. (1998) on traditional fishing techniques and whitefish processing in the Kobuk River communities, Uhl and Uhl (1977, 1979) on whitefish fishing at Anigaaq and Noatak in the 1970s, Anderson and Anderson (1977) on historic and pre-historic fishing sites in the Selawik area, and Burch (1998) on the seasonal rounds of Iñupiaq nations in the 19th century. For the most part, these studies focused on particular geographic areas and covered the gamut of subsistence activities. The current study takes a different perspective in that it provides a regional overview of one species. A smaller, more focused study like this is able to bring to light previously undocumented details of subsistence resources and activities. Many Alaska Native respondents, particularly elders, carry with them such a cornucopia of knowledge that one interview session on a variety of species simply cannot do justice to one particular subject.

One of the topics documented in more detail by this project was the traditional whitefish fishery at *Anigaaq* near Kotzebue. This is a particularly interesting fishery, not only for its unusual use of ditches or trenches as a harvest technique but also for its critical importance in the seasonal round of Kotzebue families from Sealing Point (Cape Krusenstern) and Sisualik. During interviews for this project, respondents described previously undocumented aspects of this fishery, including details about its timing, its social rules and organization, the construction features of the ditches, the storage of the harvest, and the strategies used by families in predicting the likely productivity of the fishery. These are important contributions to the body of knowledge about this fishery, which takes place in a vital subsistence use area in the heart of one of the Western Arctic National Parklands.

The interview material from this project also revealed interesting local distinctions in regard to whitefish harvest and use. These distinctions derive mostly from the specific ecological conditions found in the vicinity of each study community, leading to differences in species availability, seasonal movements of fish, and harvest and processing techniques. Highlights of the research findings regarding subsistence fishing include the following:

• Seines are the predominant harvest gear for whitefish in Noatak and in the upper Kobuk River communities where
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whitefish gather in large numbers prior to spawning and where river conditions are suitable for seining. Gillnets are the primary harvest gear used in the coastal areas near Kotzebue and in the delta communities of Noorvik and Selawik.

- In Noatak and to a lesser extent in Kotzebue, men are the primary fishermen while in Selawik and the Kobuk River villages women are largely responsible for fishing. The reasons for this are not entirely clear, but perhaps have to do with traditional social organization as it related to the yearly cycle of subsistence activities. In the late 19th and early 20th centuries, for instance, men in the upper Kobuk spent the summers hunting game in the Brooks Range, leaving women, children, and old men alone along the rivers to fish. During the same era, most Noatak and Kotzebue families summered along the coast north of Kotzebue, hunting marine mammals and participating in the summer trade fair at Sisualik. It is also possible, however, that gender differences among villages in the organization of fishing originated in more contemporary times for reasons not well understood.
- Although all the study communities fish for whitefish in both spring and fall, the major season for whitefish harvests varies among them. In Selawik and Noorvik spring is the primary season for whitefish harvests, whereas in Noatak, Kotzebue, and the upper Kobuk fall is the primary season. This is perhaps associated in part with the availability of whitefish: Noatak and the upper Kobuk villages are located near major spawning areas for whitefish, while the delta communities of Selawik and Noorvik are located near major wintering and feeding areas for whitefish. Kotzebue fits neither of these neatly; residents fish in the fall, but near summer feeding areas—not spawning areas—where whitefish become trapped in coastal lagoons. A recent fisheries study in the lower Selawik River found that whitefish were much more abundant there in June than in September (Brown 2004).
- A traditional harvest method for whitefish in the Kotzebue Sound region involved constructing fences with spruce, willows, or chicken wire across streams, sloughs, or channels of the main river. These fences blocked fish from their downstream migration, facilitating the harvest of large quantities which were frozen whole and stored for human and dog consumption later in the winter. Although rarely used

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today, some elders retain knowledge of this harvest method. This harvest technique fell into disuse with the decreased demand for dog food and with the increased availability of commercial nylon nets.

- Throughout the region, placing whitefish gillnets fully across small streams and sloughs is a widespread practice at certain locations and under certain conditions. This fishing technique is primarily used during a brief period after break-up, typically at outlets to lake systems.
- In addition to *Anigaaq*, other smaller lagoon systems in the Kotzebue area such as *Akulaaq*, *Qiliqmiaq*, and several on the Baldwin Peninsula impound whitefish through natural processes in some years. These lagoons are traditional locations for small-scale whitefish fisheries.

In addition to these highlights, the study also documented many other aspects of whitefish natural history and subsistence use, including the characteristics of each species; distribution, seasonal movements, spawning, and feeding habits of whitefish; observations on whitefish abundance and health; interactions of whitefish with other animals; traditional lore; subsistence fishing practices by community; and the processing, storage, and preparation of the whitefish harvest. All this contributes significantly to the general body of recorded knowledge of whitefish in the Kotzebue Sound region.

Recommendations

This project provides a foundation for understanding the natural history and subsistence use of whitefish as seen by Iñupiaq residents in selected communities in the Kotzebue Sound region. Room remains for additional biological and cultural research to build on the findings of this project. Because many of these fisheries take place in federal waters, these suggestions should be of interest to both federal and state resource managers. Specific recommendations for additional work include the following:

1. Additional investigations of Iñupiaq taxonomy of whitefish in Selawik. Selawik has a complex and subtle classification system for whitefish, the details of which eluded researchers in this project. Further field work by skilled bilingual researchers in association with biologists would be useful for clarifying the Iñupiaq naming system for whitefish

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in Selawik, its relationship to scientific taxonomy, and the distinctive characteristics of each species.

- 2. Expanded research on traditional knowledge of whitefish. This project covered selected communities representing the physical geography of several natural environments in the Kotzebue Sound region. Other important and distinct areas in the region, such as the northern Seward Peninsula and the Chukchi Sea coast north of Kotzebue, were not included in this study. Similar research in the communities of Deering, Buckland, Shishmaref, and Kivalina would result in a more comprehensive regional overview of traditional knowledge of whitefish.
- 3. Harvest assessment in Selawik. Many communities in the Kotzebue Sound area have at least one year of quantified data on subsistence harvests of whitefish. Several communities have multiple years of data, though not by species in most cases. Selawik is the exception to this, where no comprehensive whitefish harvest data have ever been collected. This information would add an important component to a regional overview of subsistence whitefish harvests, especially given the large size of Selawik and the central role of whitefish in its seasonal round.
- 4. Land use and place name mapping. A more thorough documentation of historic and contemporary locations of fish camps, fish traps and weirs, and other key fish harvest sites would provide a spatial perspective on fishing that would be of long-term value. Associating place names with these sites would also be useful, whether from existing sources or new research. Extensive place name mapping has already occurred in much of the Kotzebue Sound region, but gaps in these data remain.
- 5. Biological investigations. Whitefish have generally been overlooked by many fishery managers and research biologists despite its importance as a subsistence resource in the region. Until recently very little scientific research has taken place on whitefish (other than sheefish) in the Kotzebue Sound region. Biological research would be beneficial on any number of topics, such as whitefish spawning areas, range, critical habitat, and seasonal movements. Information from this current project on traditional knowledge can provide direction to biological research on whitefish.

- 6. **Beavers and whitefish.** The impact of beavers on whitefish is a topic of continuing concern to many local residents. Additional documentation of changes in beaver abundance, associated changes in the environment, beaver hunting patterns, and areas most impacted might be useful. Brief summaries of biological research on the relationship between fish and beavers should be disseminated to the public, and the value of additional biological research or monitoring should be discussed.
- 7. Traditional knowledge research on other fish species. This project demonstrates that a narrowly focused research topic can reveal previously undocumented details about subsistence activities and traditional ecological knowledge. Additional traditional knowledge studies on other fish species, such as salmon, Dolly Varden, northern pike, or burbot, would likely uncover details about these species equally as interesting as this project found about whitefish. In the Kotzebue Sound region, the greatest contribution to the existing literature can be made by this type of specific, detailed study on a particular community or species. The more this kind of work can be accomplished, the more traditional knowledge will be recorded for future generations.

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U.S. Fish and Wildlife Service

1993 Selawik National Wildlife Refuge Fishery Management Plan. Fishery Resource Office, Fairbanks, and Selawik National Wildlife Refuge, Kotzebue, Alaska.

APPENDIX A: INTERVIEW GUIDES

INTERVIEW GUIDE TRADITIONAL KNOWLEDGE OF WHITEFISH IN SELAWIK

Natural History

- There are several kinds of whitefish in the Selawik area. Can you talk about these different kinds of whitefish and what you know about them? What are their local or Iñupiaq names (general name, group or species names)?
- What can you tell me about the seasonal movements of the different whitefish? (their timing into and out of lakes, up and down the river, etc.) Are different kinds of whitefish found together?
- Where do whitefish spend winters?
- Where do they spend summers?
- Where and when do whitefish spawn? How often do they spawn? Which kinds do you see in spawning condition?
- What happens to the eggs after spawning? When do they hatch?
- What do you know about juvenile whitefish? Where are these found? Are juveniles distinguished by species?
- What do whitefish eat?
- How long do they live?
- How do things like water level, temperature, ice thickness, etc. affect whitefish? What conditions does each kind of whitefish prefer? (such as depth of water, temperature and clarity, speed of current, vegetation, gravel or mud bottom, etc.)
- How do whitefish relate to other kinds of fish and animals (sheefish, pike, otters, mink, bears, etc.)?
- Do floods have a role in the lives of whitefish? Has this changed over time?
- Do you think the number of whitefish is increasing, decreasing, or about the same as in the past? Why?
- Have you noticed any changes in the health, size, or condition of whitefish? Do you ever see large numbers of dead whitefish?

Whitefish and Beaver

- What is the history of beaver in this area?
- Is the number of beaver increasing, decreasing, or staying about the same? Why?
- What effects (good or bad) do beavers have on whitefish? How has this changed over time?
- Do beavers affect some kinds of whitefish more than others?
- What effects do beavers have on other fish, animals, or plants? How has this changed over time?
- Which areas have been most affected by beavers? (look at map)
- Have you noticed other environmental changes that might be affecting whitefish? (such as more or fewer floods or fires, areas drying up, etc.)
- Were there things people traditionally did to discourage beaver dams or to encourage whitefish populations?

Fishing

- When does whitefish fishing take place? What kind of gear is used in each season? (length and size of nets, etc.)
- What do you look for in selecting an area to fish for whitefish? Which local areas are known for particularly good whitefish fishing? (look at map)
- Are fish traps used to catch whitefish? Were these used in the past? Could you talk about this?
- Are whitefish nets sometimes placed all the way across the mouths of sloughs and streams? How long are these nets? Could you describe when and how fishing takes place in these cases?
- Which kinds of whitefish are preferred?
- Does the quality of whitefish change with the seasons? When are they the fattest and in the best condition?
- What are the general processing or preparation methods used for whitefish? (dried, half-dried, frozen, fresh, etc.) What are the Inupiaq names for these?
- Are the different kinds of whitefish utilized in different ways?

- Could you talk about the use of whitefish for dog food?
- Are juvenile whitefish used for anything?
- How has whitefish fishing changed over time? Could you talk about this? (quantities, fishing methods, dog food, seasons, etc.)
- Are there any traditional laws guiding whitefish fishing? Are there special ways to treat whitefish?
- Do you know any old Eskimo stories that feature whitefish?
- Do certain fishing areas belong to certain families?
- Were there things people traditionally did to make sure that whitefish stayed plentiful?

INTERVIEW GUIDE

TRADITIONAL KNOWLEDGE OF WHITEFISH IN THE KOTZEBUE AREA

Natural History

- Which areas do you usually use for whitefish fishing? Is there a particular reason you use these areas? (look at map)
- In which seasons do you usually fish for whitefish?
- Can you talk about which kinds of whitefish you catch at which times of year? Which names do you use?

qalupiaq?—all kinds of whitefish *qausiluk*?—broad whitefish *qaalġiq*?—humpback whitefish *iqalusaaq*?—least cisco *tipuk*?—Bering cisco *siyyuilaq*?—broad whitefish? *quptik*?—pinkish-orange fins (round whitefish)

- What do you know about the seasonal movements of the different whitefish? Where do they spend winters? Summers?
- How is spring fishing different than fall fishing? (species, processing, location)
- Have you seen places with large whitefish die-offs? Where? What might have caused these?
- Where and when do the different kinds of whitefish spawn? How often? Which kinds do you see in spawning condition?
- What do whitefish eat? How long do they live?
- How do whitefish get along with other kinds of fish and animals (sheefish, pike, otters, mink, bears, etc.)?
- Do you ever see juvenile (young) whitefish? Where are these found?
- What conditions do the different kinds of whitefish like? (such as water depth and temperature, ice thickness, speed of current, vegetation, type of river bottom, etc.)
- Do you see whitefish with bumpy or rough skin? At what times of year? Which kinds of whitefish have this?

Anigaaq

• Can you talk about the Anigaaq fall fishery? When did this usually take place? How long did it last? How many ditches were usually dug? Which kinds of whitefish were caught?

- Are ditches sometimes dug at other lagoons (Akulaaq, Kotlik, etc.)? Which kind of whitefish are found in these?
- When does the mouth of Anigaaq typically close? How early and late does it sometimes close? How does the timing of the closing affect whitefish availability and abundance?
- How often does the Anigaaq fall fishery fail? What did people do then?
- Do you fish for whitefish in places other than Anigaaq?
- Have you heard people say that Anigaaq whitefish are connected to Selawik whitefish? What do you know about that?
- Have you seen a place in the clear stream (Situkuyok) near Anigaaq where whitefish sometimes gather in the winter? What determines whether this occurs?
- Do people fish for whitefish in the spring at Anigaaq? In the ocean?
- Are you familiar with rules guiding the Anigaaq fishery? Could you describe these (each family had their own area, no loud noise, no seining or nets)? Are there other traditional laws guiding whitefish fishing? Are there special ways to treat whitefish?
- Can anyone fish for whitefish at Anigaaq, or does this area belong to certain families? What about other areas near Kotzebue?
- Are *iqalusaaq* eggs the only ones eaten fresh?

Abundance

- Has the whitefish population fluctuated (gone up and down) over time? What determines whether there are many or few whitefish?
- Is there a way to tell whether whitefish will be abundant or scarce in the coming year?
- Do you remember times when there were few or not enough whitefish? If so, what caused this?
- Do you think the number of whitefish is increasing, decreasing, or about the same as in the past? Why?
- How do floods or high water affect whitefish? Has this changed over time?
- Have you noticed other changes in the environment that might be affecting whitefish? (such as more or fewer fires, areas drying up, etc.)
- Are there things people need to do for whitefish to come back every year?
- Have you noticed any changes in the health, size, or condition of whitefish?
- Have beavers affected whitefish in this area? Why do you think beaver numbers have increased in recent years?

Subsistence Fishing

- What size of net do you use in each season?
- Which kinds of whitefish do you prefer? Why? Does the quality of whitefish change with the seasons?
- How much whitefish do you catch?
- Are whitefish nets sometimes placed all the way across the mouths of sloughs and streams? Could you describe this (when, where, and how)?
- How are different kinds of whitefish utilized and processed at different times of year? (dried, half-dried, frozen, fresh, *amatchiaq*, dog food, etc.) Are whitefish mostly used for quaq in the Kotzebue area? Or dried fish? Why are whitefish often scaled?
- Could you talk about the use of whitefish for dog food? Were whitefish a major source of dog food in the past? How were these put away?
- How has whitefish fishing changed over time? Could you talk about this? (quantities, fishing methods, dog food, seasons, etc.) Were fish traps or dip nets used near Kotzebue in the past to catch whitefish?
- Do you know any old Eskimo stories that feature whitefish?
- Are there traditional laws guiding whitefish fishing? Do certain fishing areas belong to certain families?
- Who else would be good to talk to about whitefish fishing?