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“Alaska Subsistence Fisheries Database GIS Integration”
Final Report Number: FIS 02 043



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ABSTRACT

The Alaska Subsistence Fisheries Database GIS (ASFDB GIS) incorporates subsistence salmon permit harvest data with a series of maps depicting Alaska communities and the locations of harvests around the state. This project is similar to the Southeast Alaska GIS (FIS00 039, FIS01 103, FIS02-038), in which existing subsistence permit data from Southeast Alaska were received from the Alaska Department of Fish and Game, Division of Commercial Fisheries, and transferred to the digital map interface. This project includes Division of Commercial Fisheries subsistence permit harvest data from Alaska Peninsula and Kodiak Island communities; other fisheries that require permits around the state do not have a standardized method of reporting harvest location, and are therefore not included in this project's GIS database. Harvest locations are visible on the digital maps of Alaska, and can be sorted and queried based on harvester's community of residence, total years' quantity of harvest, number of permits fished at a given location, and yearly harvests for a given location. Data can be copied from the project and used as a map overlay in other GIS projects, or in tabular form. By depicting the harvests spatially, the ASFDB GIS assists fisheries management by highlighting the geographic characteristics and relationships of subsistence harvests.

Keywords: Database, Fisheries, Geographic Information Systems, Maps, Permits, Salmon, Subsistence

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INTRODUCTION

Subsistence salmon fishing in Alaska is conducted under various types of regulatory structures. Some subsistence fisheries do not require a permit and have no restrictions on season or bag limit. Others do require that fishers obtain an Alaska Department of Fish and Game (ADF&G) permit that asks the fisher to report his or her annual harvest back to ADF&G. On some permits, the fisher is asked to report the number of salmon harvested as well as the location of the harvest. This report describes the Alaska Subsistence Fisheries Database Geographic Information System (ASFDB GIS), which displays the locations of certain harvests on a series of digital, scalable maps with interactive features. Accessing salmon harvest data using the ASFDB GIS allows the user to visualize the distribution of subsistence salmon across a particular area, and across the state.

The ADF&G Division of Commercial Fisheries issues and collects permits for several subsistence fisheries each year. ADF&G's Division of Subsistence is the office that summarizes this permit data in its "Alaska Subsistence Fisheries Annual Report." The tabular database in which the permit data exists is called the Alaska Subsistence Fisheries Database (ASFDB). This database contains information on harvest quantities, permit return rates, community participation levels, and in some cases information on the location of harvests. This tabular database, housed on the computer network at the Division of Subsistence office, provided the basic information for the maps in the ASFDB GIS, the finished product of this project.

The ASFDB GIS integrates data from the ASFDB with a system of maps depicting Alaska coastlines, rivers, and communities. The tabular ASFDB contains information on harvests in specific locations for three regions of the state: Southeast, Kodiak Island, and Alaska Peninsula. The harvest locations documented for three other permitted regional fisheries, Northwest, Chignik, and Bristol Bay, are still being formatted as part of the on-going development of the ASFDB.

In 2000, the USFWS Office of Subsistence Management began funding for the creation and succeeding updates to the Southeast Alaska Subsistence Salmon GIS Database (FIS 00 039, FIS 01 103, FIS02 038), which mapped subsistence permit harvest information from Southeast Alaska fisheries. That GIS database has been reviewed by representatives of the US Forest Service in Juneau, as well as tribal organizations and members of the Subsistence Advisory Council in Southeast Alaska, and has been judged a useful tool in depicting and conveying information about subsistence fishing in that part of the state.

Documenting the locations of subsistence harvests provides useful information for those who manage subsistence resources. Subsistence salmon harvest maps, like those provided in this GIS project, provide fisheries managers with a valuable perspective on the geographical context in which resources, harvesters, other users (commercial, guided

sport, etc.), and other factors (industry, development, catastrophe, etc.) all come together as part of a dynamic ecosystem.

This project, "Alaska Subsistence Fisheries Database GIS Integration", FIS02 043, brings the other two regions with harvest location data into a GIS format: Kodiak Island and the Alaska Peninsula. Together, the ASFDB GIS and the Southeast Alaska GIS represent all of the available harvest location information and present it in a graphically accessible format.

The ASFDB GIS was written using Environmental Systems Research, Inc. (ESRI) ArcView 3.2 software and was designed to allow the non-technical user to query subsistence harvest databases by using simple menu selections, or by "clicking on" maps showing communities or streams. Through scalable maps showing any particular region, community, drainage or water body, the ASFDB GIS makes important fisheries information available to a wide audience.

In the ASFDB GIS harvest data are available not only for numbers of salmon but also for numbers of fishing households (number of permits returned), and these are organized by location, by year, and by the fisher's community of residence. The depiction of these variables and categories is interactive, with the user choosing different graphic characteristics to represent a specific inquiry. (Examples are provided in the Results section of this report, and illustrated in Figures 1-5.) Harvest tables showing all data parameter variables are also available in the ASFDB GIS. The principal investigator created customized dialogue boxes that assist the user in defining selection criteria through standard query language (SQL) parameters, which then produce thematic maps containing the requested information.

This project is consistent with the recent protocols established by the State of Alaska to make public information more easily accessible by government agencies, organizations, or by the public at large. The State of Alaska Geographic Information Advisory Committee, within the Office of the Lieutenant Governor, issued a report titled "Geographic Information System Strategic Plan" in October 2000. The report emphasized the need to share geographic information within state agencies and with the public, to enhance the usefulness of spatial information in government decision-making, and to create compatibility of information being created and stored by state agencies. The ASFDB GIS is aligned with the goals of the statewide plan, including the standardization of data formats by using ADF&G harvest locations. ESRI platform products are the national standard. The data can be run from the CD as a stand-alone Arc View project, or it can be copied and used in other GIS projects modeling land and resource use. Beyond the realm of state and federal government agencies, making the GIS available to and used by local communities for special resource management projects will automatically extend the standardized data format to those projects, creating compatibility with the larger governmental operations.

Another concern of the statewide plan is to use geographic information to enhance public awareness of and participation in governmental decision-making processes.

Public access to information on subsistence fisheries is an important facet to the public proposal, commentary, and assessment components of the federal management and regulatory process. By making more information available on subsistence harvests and giving the public the opportunity to educate themselves on this aspect of resource use in Alaskan communities, managers are helping to ensure fair and effective participation in the regulatory process. Making harvest data available for public inquiry, research, and use serves the management of Alaska's resources overall.

Understanding the ways subsistence practices are carried out in different parts of Alaska is an important part of the management of fish and wildlife resources. These practices vary significantly from region to region. Environmental factors, linked to geography, are fundamental to the organization of subsistence systems. They influence the relative availability and importance of different species, the seasonality of harvests, as well as the level of community participation in different fisheries. Other factors of geography, such as proximity to population centers, former village sites or traditional inter-group boundaries also influence the overall subsistence patterns for a community or group of communities. Depicting harvest data using tables and charts might refer to geographic locations, but the spatial relationships are not immediately apparent. Maps that display harvest information makes the importance of location more intuitive and demonstrative.

The Division of Subsistence has collected and published subsistence harvest data for over 20 years. These data provide state and federal managers with a thorough understanding of how, when, where, and in what quantities natural resources affect and sustain Alaska's communities. Subsistence maps figure prominently in the Division's work. The Alaska Board of Fisheries and the Federal Subsistence Board both use these map documents to better understand subsistence harvests and the geographical relationships of subsistence users and fish stocks (AS 16.05.258(a)) (Section 36 CFR 242.24(a)(2)).

Subsistence harvest maps often show the areas important to communities' subsistence activities, and are useful when discussing the potential effects of development at those locations, or changes in fisheries management plans, or other management decisions relating to access and proximity. In conjunction with sport, commercial, environmental, and demographic data, as well as other subsistence fisheries harvest data, geographical information on subsistence harvests can provide valuable perspective to the management of fish resources and the protection of subsistence uses.

In addition to the user-friendly design of the ASFDB GIS interface, the underlying data files can be copied and used in other mapping projects. People using GIS to model certain environmental scenarios may add the subsistence salmon harvest data to their understanding, overlaying the data onto their own maps showing timber harvest locations, commercial fishing districts, oil spill preparedness zones, cruise ship traffic lanes, or other activities. Distributing the ASFDB GIS as an easy to use, harvest mapping program also allows individuals with more specialized interests access to the spatial data files for their own particular uses.

The ASFDB GIS organizes existing subsistence harvest data into an interactive, inquiry-supporting database where the geographical relationships between harvest locations are explicit and easily recognized. With the increasing role that federal agencies are taking in the management of subsistence fisheries in Alaska, accessible information on harvest amounts, locations, and uses is vital to best management practices by both federal and state managers.

OBJECTIVES

Specific objectives of the project included:

1. Provide a graphic means for selecting, querying, and depicting subsistence fisheries information.
2. In depicting the spatial characteristics of subsistence fisheries on a system of maps, facilitate research related to those fisheries' harvest locations.
3. Provide a standardized framework that can be used by other projects for displaying fishery information on participating households and harvests of individual salmon species by community, location, or drainage.

The ASFDB GIS makes subsistence fisheries information from the Kodiak Island and Alaska Peninsula areas accessible in the form of digital map with interactive functionality. For each harvest location, information on the salmon harvested from that location is available, with divisions by species, by the harvester's community of residence, and by year (Objective 1). The data in the ASFDB GIS is searchable much like the Microsoft Access version of the ASFDB itself, with harvest numbers linked to the locations on the map in the form of tables (Objective 2).

The tabular data contained in the ASFDB were mapped in ArcView, but not all harvest data reported on subsistence permits are ascribed to a particular harvest location. Permits for Kodiak Island and Alaska Peninsula areas do have fairly standard reporting formats that allow for continuity from one year to the next. Some of the other regions of the state (e.g. Northwest, Bristol Bay, Chignik) collect harvest location information, but synthesis of that data has not been completed within the ASFDB. Therefore, only the harvests recorded for known harvest locations are included in this project. Southeast Alaska harvests are not included on this project, but are available in a separate GIS.

The user is able to select what kind of harvest information he or she is interested in. Search criteria include: a particular year or range of years, a particular community or set of communities, a particular species of fish, and/or a particular water body. The results of these database selections are displayed in the form of spreadsheet-type tables

within the project, as well as visual representation on the map interface. Queries based on data parameters, such as highest-harvesting communities, communities with a certain level of participation, or streams with a certain number of fish harvested, are also possible. The communities and/or water bodies that fit the criteria are then illustrated on the map itself (Objective 2).

Division of Subsistence harvest assessment work involves estimations of harvests on a community-wide basis. Permittees list their community of residence on the permits, and that became a variable in analyzing harvests (as in the ASFDB). For this project, only communities located in the general area/district of the fishery were mapped. For example, Kodiak Island salmon harvest data reflect the harvest activity of people whose homes are in Kodiak Island communities. Likewise for Alaska Peninsula harvest locations. Salmon harvests by residents of communities such as Anchorage, Juneau, Bethel, Soldotna, etc. are not included in this project. The data are presented with “Community” as one variable, and the summed “All Communities” in this case means all communities in that region, either the Alaska Peninsula or Kodiak Island.

Formatting the data from the ASFDB, preparing it for integration into the GIS, took the principal investigator more time than he had originally planned. The ASFDB stores harvest data cross-referenced with stream and waterway identification variables, but making those identification codes match took an inordinate amount of time. Identification codes had to be validated, cross-checked, and in many cases re-coded so that all the harvest data recorded in the ASFDB data tables would be transferred to the GIS. After the painstakingly detailed work was complete, all of the harvest data were woven together and became presentable as harvest maps.

Data files on the CD can be extracted and added to other GIS mapping projects. Environmental plans for timber harvest, offshore oil drilling, oil spill response, transportation, and hydroelectric projects must account for all potential environmental impacts, including subsistence, and these can make use of the information contained in the ASFDB GIS. The standardized data formatting makes it easy for others using ESRI GIS software to include subsistence harvest data in their own mapping projects (Objective 3).

The ASFDB GIS is a self-contained, portable GIS project distributed on CD-ROM that can be run using ESRI’s ArcView GIS software. Similar to distribution of the Southeast Alaska Subsistence Salmon GIS Database, the ASFDB GIS will be distributed to the appropriate federal agencies, Regional Subsistence Councils, as well as local communities and other interested parties. Copies are also available upon request from the Alaska Department of Fish and Game, Division of Subsistence, 333 Raspberry Road, Anchorage, Alaska 99518. Data formats and interactivity of the GIS make it reasonably ready for uploading onto the World Wide Web for general public consumption, as will be the Microsoft Access version of the ASFDB.

The project was created in ArcView 3 rather than in ArcView 8.1, as was described in the project proposal. When the USFWS Office of Subsistence Management

accepted the proposal, it was understood that ArcView 8.1 would be replacing the earlier version 3.2 in the immediate future, but this has not been the case. ESRI ArcView 3 users are slowly making the switch to newer version of ArcView and ArcGIS, including the GIS specialists at the Division of Subsistence. Therefore, for reasons of expediency and accessibility, the final version of this GIS project is presented with ArcView 3.

The agreement with USFWS, Office of Subsistence Management, for the work contained in the ASFDB GIS indicates that, in addition to the data contained in the ASFDB, the GIS would include locations of regulatory markers defining different subsistence fisheries. Due to the extra time necessary to format the ASFDB data tables (described above), these data were not included in the final GIS product. Any future versions of the ASFDB GIS will contain at least some of the information on current regulatory marker location and boundaries of subsistence fishing areas.

METHODS

The principal investigator first formatted the ASFDB Microsoft Access data tables for integration into the GIS database. Stream identification variables have been worked into the data structure of the ASFDB to allow for linkages with the existing ADF&G coverages, digital maps showing coastlines, streams, etc. Using Arc View 3 software a set of scalable maps was created from the harvest data, allowing for depictions by community and by water body, with different graphic characteristics illustrating specific variables (quantity of salmon, number of permits, percent of households using an area, etc.). Tables and charts depicting the harvest information were linked to the geographic features on the maps.

The investigator created dialogue boxes to assist GIS users in defining selection criteria through SQL parameters. By selecting values within the available categories (e.g. community of residence, sockeye harvest, number of permits, etc.) the user produces thematic maps containing the requested information.

The agreement between ADF&G Division of Subsistence and USFWS Office of Subsistence Management specified a final product both on CD as well as a version ready for publication on the World Wide Web. However, due to personnel changes in the Division of Subsistence Information Management office, the publication of Division data on the Web was not achieved in time for completion of this project. The ASFDB GIS should be available on the Division's website concurrently with the ASFDB, projected for mid-2005. Until that time, the GIS will be available on CD for use on computers that have ArcView software.

RESULTS

The ASFDB GIS comprises a series of data tables that can be displayed as “map items.” These map items contain harvest information from the Kodiak Island area and the Alaska Peninsula area, visual representations of permit counts and salmon harvest counts with reference to specific harvest locations on a map. By becoming familiar with the selection, querying, and filtering capabilities of ASFDB GIS, users will be able to better understand the subsistence salmon harvests vis a vis the geographic locations and spatial orientation of those harvests.

Several figures included in this report illustrate the functionality of the ASFDB GIS. Figure 1 shows the interface first presented to the user on the screen. The map items are listed along the left side of the window in the Table of Contents and can be turned on or off by clicking on the box to the left of the item’s name. In this example, the “Kodiak Communities” map item is turned on. Locations where Kodiak Island fishers reported harvesting salmon in 1981, and between 1985 and 2001, are represented on the map as red dots.

In Figure 2, the same map item is represented on the map view, and the map item table has been opened. The map item table contains the rows of data that correspond with each harvest location point on the map. The name of the location, the year of harvest, the community of harvester’s residence are all listed as data fields in the table. The remaining fields give sum numerical data for the location under the specified parameters: number of permits returned, number of king salmon harvested, number of sockeye salmon harvested, etc. In this figure the table has been opened and appears to overlay the map view. All windows, containing tables, query dialogue boxes, or map views, can be resized and minimized while working with different data windows.

Figure 3 shows a map view of the Alaska Peninsula region’s Cold Bay area. On this map, the map item titled “Alaska Peninsula Harvests, All Communities” is turned on and displayed, along with the table containing the map item data. Using the Selection tool in the tool bar, certain harvest locations on Cold Bay have been “selected” by a click of the mouse. These selected locations appear in yellow, both on the map view and in the data table. Selecting harvest locations, either on the map image or from the data table itself, allows the user to examine harvest characteristics of a particular location or group of locations.

Figure 4 shows the map item “Alaska Peninsula Communities” after a “Map Item Properties” query has been performed using the custom dialogue boxes built into the ASFDB GIS. The data reflect a query requesting harvest data for fishers from the community of False Pass; harvests for other communities are “filtered” from the map display. Here, the locations of False Pass harvests have been displayed using a “Graduated Color and Size” option. The map item legend in the Table of Contents

describes the harvest values for the location shown by a particular size and color of point: locations with a False Pass fishers' harvest of 62-160 are represented on the map by a 10-point pink spot, a harvest of 161-279 is seen as a slightly larger 12-point red point, 280-620 is labeled with a dark red size-14 point, and 621-920 (the most productive harvest locations for False Pass fishers) is represented by the largest, darkest red points. The colors, sizes, and value parameters for organizing and plotting the way a harvest is represented on the map are all interactive and changeable when using the ASFDB GIS.

Figure 5 shows another example of assigning different visual characteristics to certain harvest variables, making their comparison (on the map) easy and intuitive. The map item "Alaska Peninsula Communities, Years" has been queried using the Map Item Properties menu item to display only the harvest locations reported by Sand Point fishers. The data for 2000 and 2001 are displayed separately in this map item, and the locations for each year's harvest are visualized using different size and color points for easy comparison. Locations where red and yellow points overlap had harvests for both 2000 and 2001, where locations with only one color point had harvests for only its designated year.

These examples show some of the ways the ASFDB GIS can help the user to understand harvest data according to specific variables, grouping, ungrouping, and organizing the data contained in the data tables into an accessible, visual, geographically-referenced display.

DISCUSSION

This project produced no new knowledge through observation or discussion, but rather developed a new level of organization and access to existing harvest data. With the tabular ASFDB database (without the GIS component) harvest trends can be assessed and observed using numerical data, but the spatial relationships between waterways and harvests remain unknown. The ASFDB GIS makes geographical association (e.g. harvests located on a particular bay, or on neighboring watersheds, or of varying distances separation) explicit and easily understood via the visual nature of the data.

Detailed documentation of harvest locations is useful for any comprehensive, synthetic approach to subsistence resource management. This information has been used by the Alaska Board of Fisheries and the Federal Subsistence Board to determine where "Customary and Traditional" uses exist for a particular stock in a particular area. For state designations, the Division of Subsistence assists the Board of Fisheries in its assessment of the relationship between subsistence users and particular fish stocks. Part of that relationship is based on "the geographic locations where those domiciled in the area or community hunt and fish" (AS16.05.258(c)(11)). These geographic relationships contribute directly to all aspects of the subsistence fishery, from economics (e.g. gas

prices for outboard motors), to social connections (e.g. organizing a work party to travel to the fishing grounds), to culture (e.g. fishing spots used by particular families, or as part of a traditional, seasonal round). Well-documented subsistence harvest location data is essential to the task of understanding the subsistence use of salmon, and is also essential to state and federal management in its legal responsibility to provide users with a “reasonable expectation of success” (AS 16.05.258 (f)) and a “continuation of the opportunity for subsistence uses of resources” (ANILCA Section 801(3)) in those locations.

From a basic documentation of harvest locations, managers can begin to understand how geography creates inter-relationships between subsistence harvests, as well as the way other factors, as part of the ecosystem, might affect subsistence uses. These factors might include other types of harvest (commercial, guided sport), contamination, fires or flooding, or plans for the development of minerals, timber, or tourism. For all of these, location directly affects how subsistence resources will be impacted, and therefore subsistence location information must be part of the federal government’s evaluation of any proposal to use federal lands (ANILCA Section 810(a)). Subsistence salmon harvest maps are useful to management plans that seek to use an ecosystemic approach to resource monitoring, protection, and preservation.

GIS allows the user to analyze geographic information and to make observations like those described above. Aspects of proximity can be determined (e.g. distance of harvest locations from the fisher’s community of residence, from other communities, or from land forms, etc.) and distribution (e.g. harvest locations in a particular bay, along a traditional boundary, across the map in isolation or in groups, etc.). These may in turn be co-related to cultural, social, historical, and ecological elements of the subsistence patterns in the area. Using GIS, relationships such as proximity and distribution are discovered more easily than if data were only available in tables or in text.

CONCLUSIONS

The ASFDB GIS organizes existing subsistence harvest data into an interactive, inquiry-supporting database where the geographical relationships between harvest locations are explicit and easily recognized. With the subsistence harvest data available in tables, as in the ASFDB (without the GIS component), the geographic context and relationships of those data would be known to only those people with a comprehensive and infallible knowledge of the region’s harvest locations named in the tables. The ASFDB GIS makes that context, and those relationships, apparent to the average user simply by showing salmon harvest locations on a map. In doing this, the project provides a valuable dimension to anyone attempting to understand the complexities of subsistence fishing in the communities of Kodiak and the Alaska Peninsula.

RECOMMENDATIONS

The ASFDB GIS will be sent out to agencies, Regional Advisory Councils, and communities for use as a reference tool. Input and suggestions for future GIS projects will be requested of all parties. The Division of Subsistence will update the GIS with future years' harvest data, as well as expand the coverage to include other regions where harvest location data are being collected (e.g. Chignik, Bristol Bay, Northwest Alaska). Due to certain setbacks, two project deliverables were not successfully included in the final product: 1) inclusion of regulatory marker information (due to time constraints described in "Objectives" section), and 2) publication of the project on the World Wide Web (due to personnel turnover and lag-time in technological developments). The information on regulatory markers around subsistence fishing areas will be included in later versions of the ASFDB GIS, and publication on the World Wide Web is forecasted for mid-2005.

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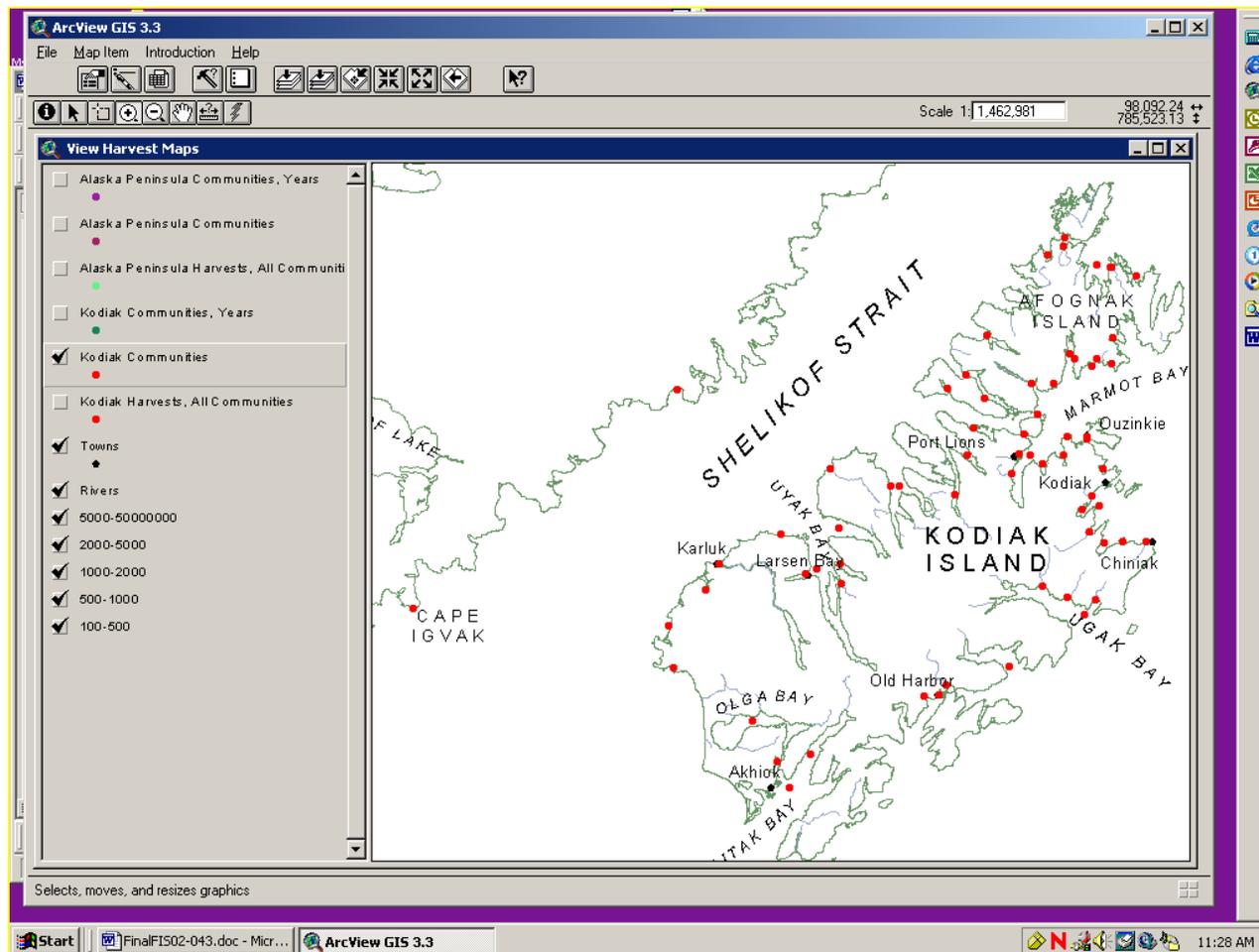


Figure 1. Map View with Kodiak Communities' Harvest Locations

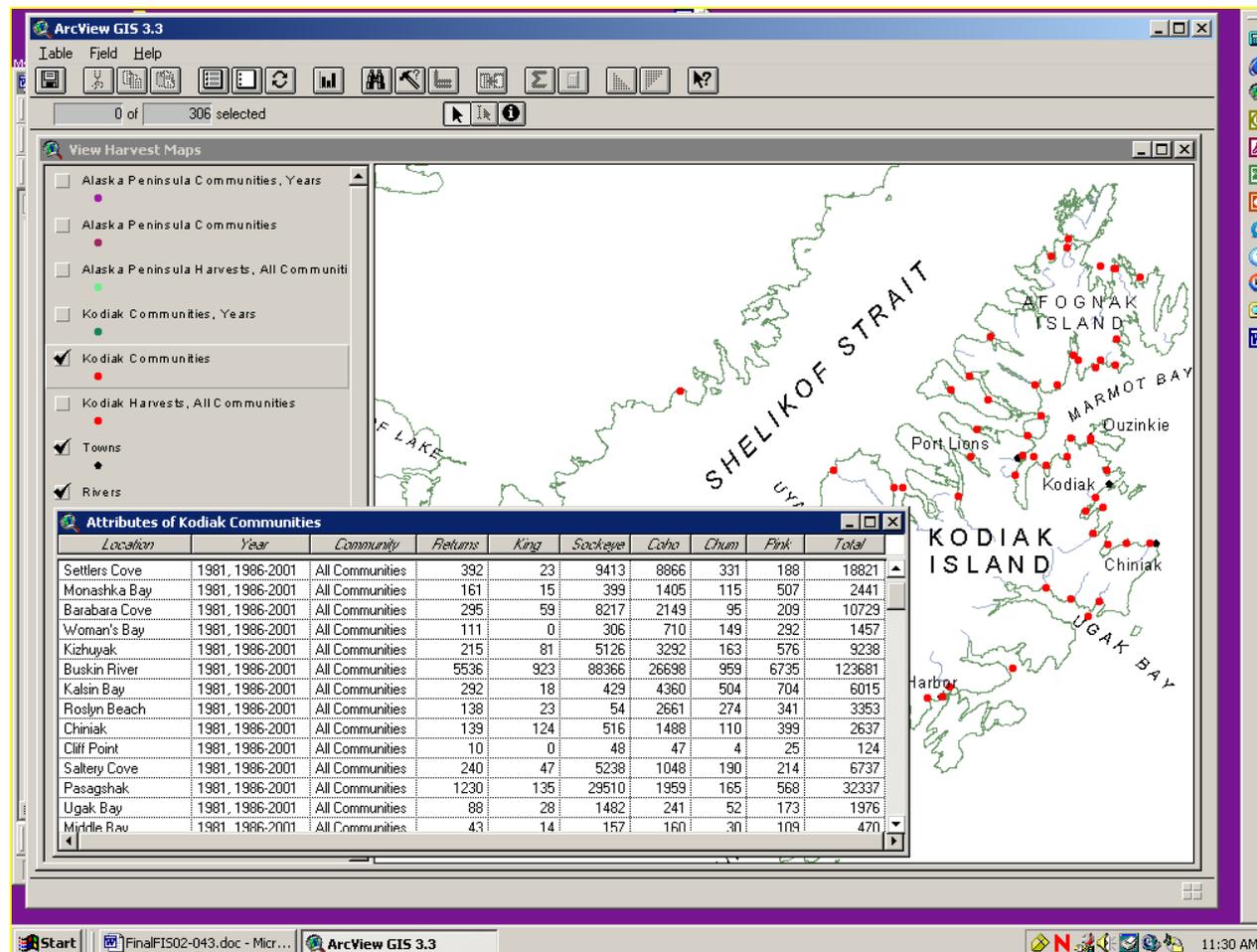


Figure 2. Map View with Kodiak Communities' Harvest Locations Table Open

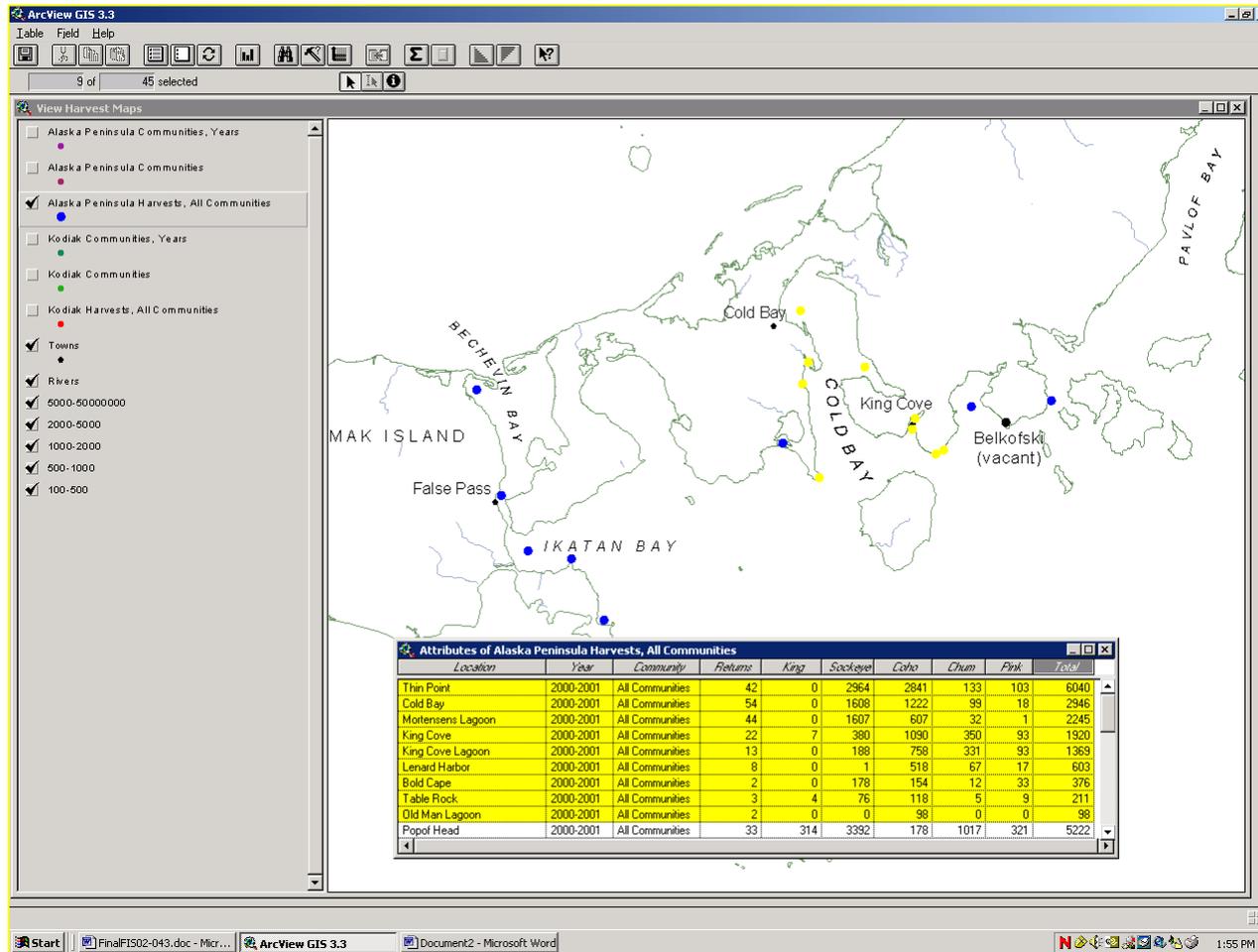


Figure 3. Map View of Alaska Peninsula with Cold Bay Area Harvest Locations Selected (on Map View and in Table)

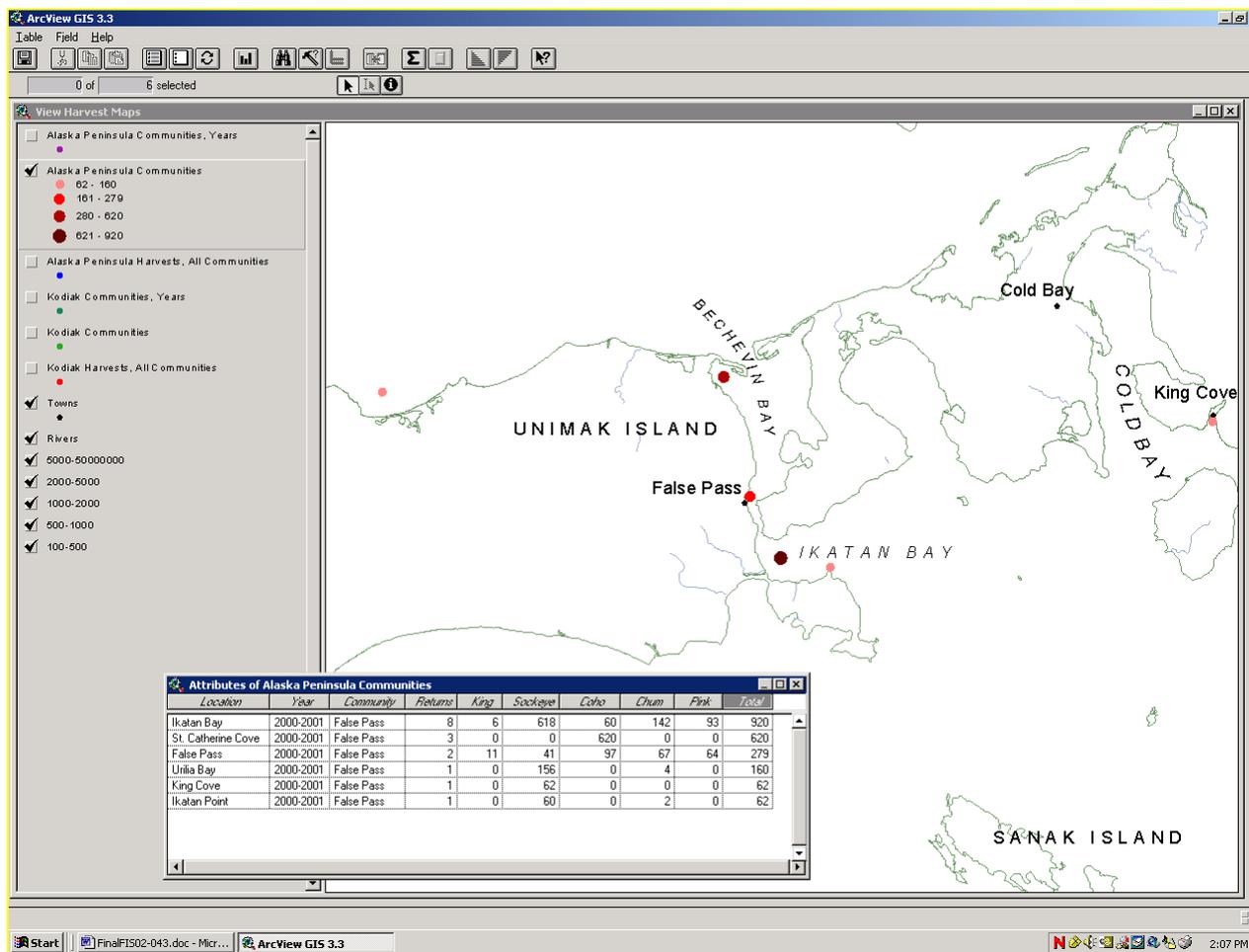


Figure 4. Map View of Alaska Peninsula Region with False Pass Community Harvest Locations Filtered, Shown in Points of Graduated Size/Color

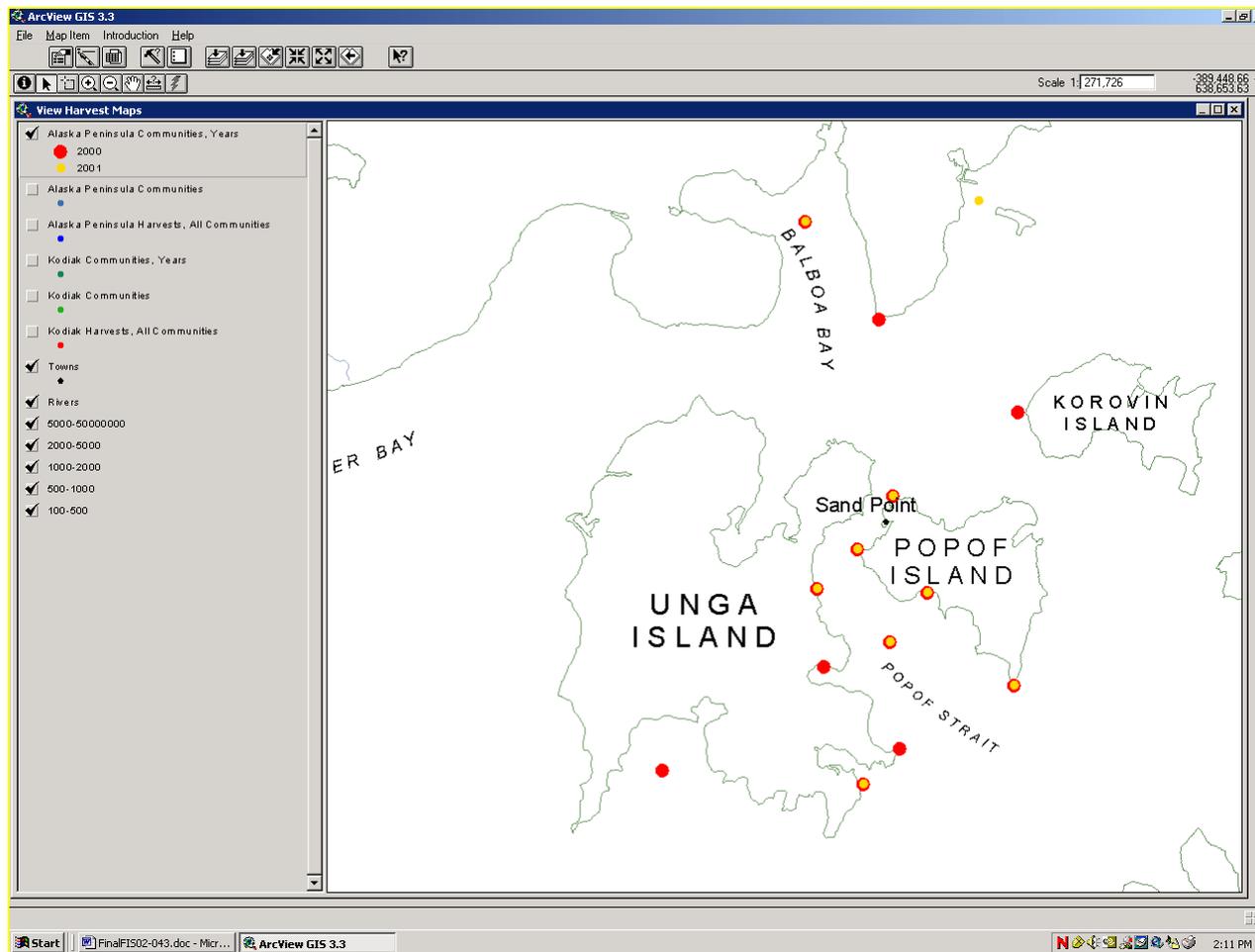


Figure 5. Map View of Unga Island Showing Sand Point Community Harvest Locations For Years 2000 (Large Red Point) and 2001 (Smaller Yellow Point)

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