AGENDA D-1
APRIL 2001

MEMORANDUM

ESTIMATED TIME
3 HOURS

TO: Council, SSC and AP Members

FROM: Chris Oliver
Acting Executive Director

DATE: May 31, 2001

SUBJECT: Staff Tasking

Attached is an updated summary of current staff tasking, along with potential new projects, which have been re-ordered to reflect priorities you indicated at the April meeting. Behind that is an updated and revised list of Council Committees, which you scheduled for further discussion at this meeting. I will go through this list of projects and once again seek your guidance on prioritization.

D1Memo.wpd

Council Staff Tasking Summary (June 2001)

Existing Priority Projects	Projected Weeks	A/E%	Comments
FMP Updates	2	100/0	Requires Council staff work in Summer 2001
AFA EIS/Proposed Rule	1	70/30	Requires Council staff work (Darrell)
AFA Report to Congress (final)	3	60/40	Draft in June (Darrell and contracts) 3 weeks after June
HAPC Stakeholder Process	2	90/10	Stakeholder process through summer
Halibut Charter IFQ	1	60/40	Prepare SOC Document
BSAI pot cod split	1	35/65	Final Action in October
Halibut Subsistence/LAMPs (BOF Process)	2	100/0	BOF Process in April/May - Council review and direction in June
Develop RFP's/SOWs for AFA funds	2	30/70	Requires interaction with ADFG, NMFS, and SSC in April/May (Chris/Darrell)
Observer Program (short-term changes)	2	50/50	Report in October
SSL Measures (Committee & Analysis)	**20**	**50/50**	**Major project - through September**
GHL Amendment	0	50/50	Finalized for SOC review.
Other AFA related Measures - MTC proposal	0	80/20	Review in April
Other Species(Shark/Skate) FMP amend. and CDQ aspect	3	65/35	Review this fall.
Break out 'other species" (GOA)	2	80/20	Council/NMFS Staff - Oct/Dec timeline - Need Council Guidance
GOA Salmon bycatch reduction measures (Discussion Paper)	2	50/50	Review in December
TAC Setting Process	1	20/80	Review this fall.
Community based QS (GCCC buy in proposal)	4	40/60	Council direction in June

Pending Projects

BSAI Crab Rationalization (Committee & Analysis)*	**12**	**30/70**	**Major project - pending Council direction (Maria Tsu + contract help)**
Halibut Subsistence/LAMPs (new reg amendments)*	?	50/50	Pending direction in June after BOF report
SR/RE retention*	2.5	65/35	Not started
BSAI P. Cod Trawl LLP recency in BSAI*	**10**	**30/70**	**Tasked in February - Not started - Possible Contract - with AFA funds?**
CDQ Regulatory Amendment (Administrative)	1	30/70	Discuss in June - Policy Committee Report
Three separate sideboard pools	4	35/65	Not started - Pending Council direction
P.cod reg. Amendments (2)	4	35/65	Not started - Pending Council direction - may depend on SSL measures
P. Cod sideboards (Prichett proposal)	**6**	**30/70**	**Tasked in February - Not started - Possible Contract - with AFA funds**
Groundfish processing s/b, IR/IU, HMAP	8	40/60	Tasked in February - Begin work after October 2001
Opilio VIP	2	50/50	Tasked in February - Not started
Catch/bycatch disclosure (vessel level)	1	90/10	Discussion paper in June
IFQ amendments	?	50/50	Pending Council direction
EFH EIS	**?**	**70/30**	**Potential major project - Discuss in April/June Committee Report**
CDQ Reg amendments (omnibus)	?	30/70	On hold pending tasking priorities
GOA rationalization (Committee & Analysis)	?	30/70	Pending Council direction & committee appt - Discuss in Feb/April
Increase US ownership to 75% for Commercial IFQ fleet	?		
Scoping paper on fee/loan program for IFQ Charter (NMFS?)	1	70/30	
Charter IFQ Community Set-Aside	4	60/40	Pending Council Direction

*Identified in April as a Council priority

D-1

Digital Observer Project

Date: 11 June, 2001

To: Members of the North Pacific Fishery Management Council

From: Mark K. Buckley Manager, Digital Observer Project

Re: Requests to the Council under "Staff Tasking"

The Kodiak-based Digital Observer Project seeks develop a new computer and video monitoring system that will supplement, or in some cases replace, human observers in Alaska's longline fisheries. The project will accomplish this by using off-the-shelf camera systems and high technology hardware. Additionally, we are creating new software--the core of which enables computers to recognize individual fish by species. Also involved in the system will be a GPS interface and a satellite communications uplink. Longliners are our target because the fish are hauled one-at-a-time, allowing the computer the opportunity to view each fish individually.

The project formally began 13 months ago when the Alaska Science and Technology Foundation awarded us a research grant. The project is comprised of an ad-hoc group including Digital Observer LLC of Kodiak, software developer SciFish of Anchorage, and the Department of Computer Sciences at the University of Alaska Fairbanks. NMFS has also been acting in an advisory and collaborative capacity.

The intervening months have seen good progress toward building our system. On June 7 a SciFish computer scientist and I gave a presentation to interested parties as part of this Council gathering in Kodiak. That presentation focused mostly on the project's technology and was attended by three Council members.

As the project pursues its technology goals we must also pursue the goal of regulatory change. Today there is no provision in the regulations that allows data from a machine to substitute for that generated by a human observer. This de facto prohibition is of concern to us and to our principal backer, the Science and Technology Foundation. The foundation is reluctant to continue project funding unless we can demonstrate there is some likelihood the regulations can be changed to allow for the deployment of devices such as ours. In other words, we can invent the best technology in the world, but unless there is strong political support for it the technology will go nowhere.

Over the past year the Digital Observer Project and/or the general concept of pursuing video monitoring technology in lieu of human observers has been endorsed by this Council's Observer Advisory Committee and its SSC. Two independent consultant groups under contract to NMFS: the IPHC and MRAG-Americas, Inc., have both recommended that the agency support video monitoring technologies. Additionally, last month the SSC of the Western Pacific Fishery Management Council in Honolulu endorsed the pursuit of this technology.

Political support for this technology is building, and a statement of support from this Council would go a long way toward allaying our concerns over the potential for regulatory acceptance.

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But even with the hoped-for support from the Council there appears to be some confusion as to just what route we will need to go to achieve regulatory change. Some informed people feel that NMFS can unilaterally make the necessary changes. Others believe the Council can act independently to make whatever changes it deems acceptable. Still others believe the Council and NMFS must work together.

The Project has no strong preference for any one of the above alternatives, other than to say that NMFS must be involved in an important capacity. But we would like some guidance as to what route you think we should travel.

Therefore, we are today requesting two actions of the Council:

1. A resolution supporting the concept that properly-developed video monitoring systems could be useful tools to monitor the fisheries of the North Pacific and Bering Sea and that continued development and perfection of this technology should be encouraged.

and,

2. A request to the NPFMC Staff that they determine who has the authority to make the regulatory changes necessary to deploy this technology, and then to advise all interested parties as to their recommended route to achieve the necessary regulatory changes.

D-1

Digital Observer Project
Presentation to the North Pacific Fishery Management Council
7 June, 2001

Mark K. Buckley, Project Manager
Eric O. Rogers, Ph. D. Chief Systems Engineer, SciFish

Presentation summary

The mission of the Digital Observer Project is to supplement or replace onboard observers in longline and other fisheries through the use of camera systems, computers, and communication and image recognition software. The project's vision is to provide observer information to government with high accuracy. Benefits to industry will be dramatically lowered observer costs and risks associated with having human observers aboard coupled with access to accurate, real time production statistics.

Every component of the package, with the exception of fish recognition software written specifically for this application, is available on the market. One component, the Electronic Fish Catch Logbook, has already been approved for use on the Pacific Coast by NMFS. A simpler version of a video monitoring system is currently permitted for use in Canada's offshore sablefish fleet.

This project seeks to incorporate elements of the Canadian system into ours and to improve them through software and hardware enhancements.

The initial, $582,000 phase of the project--which began in May 2000 and will end in October 2001--seeks to prove the concept that machine vision can be used to identify longline-caught fish in real time. Our principal source of funds is currently a $356,000 grant from the Alaska Science and Technology Foundation with matching funds from other government sources and industry. We expect the research and development phases of the project to be completed in late 2002, at which time we will have ready a working system suitable for deployment on commercial vessels.

In 2000 we collected just under 100,000 images of longline-caught fishes that were hauled aboard vessels engaged in the sablefish fishery. We started with the longline sablefish fishery because it has an observer coverage requirement and because species most fish sablefish longliners catch fall into one of six categories: sablefish, grenadier, Pacific halibut, shortraker/rougheye, Thornyhead and arrowtooth flounder.

Our findings to date indicate that machines can identify fish by species as they are hauled from the sea. Over the winter our software engineers trained a type of software called a "Neural Net" to identify those fish by species. Laboratory simulations have indicated the "alpha" version of our fish recognition software can correctly identify up to 80 percent of the fish in the species set we are working with. The software engineers are continuing to investigate four different types of neural net to determine which one will yield optimum performance. A demonstration cruise planned for May-June will provide the system's first field test.

The purpose of this presentation to the SSC is to introduce this group to the project. We also wish to follow up on recent, independent recommendations that regulators allow deployment of video monitoring systems on commercial fishing vessels. Our goal is to initiate a dialogue that will ultimately result in the passage of regulations allowing some fishermen the option of deploying either a human observer or a digital observer on their vessels.

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Background:

The video monitoring system we envision is ideally suited for longliners because the fish are hauled from the sea one at a time, allowing time for the camera to capture images of each fish and for the computer to analyze each image.

When it's implemented, the Digital Observer system will be attractive to a broad base of the industry. It will ease the industry-wide observer labor shortage, freeing up observers for boats or areas where the system is not yet in use. Government will benefit through assured regulatory compliance and an improved data stream. Because observer coverage is mandatory in varying degrees, today's fishermen have little choice when it comes to taking observers on their boats.

To monitor the catch and regulatory compliance, the federal government requires that longline vessels over 60 feet in length carry an observer for at least part of their fishing time. The largest vessels must carry an observer all the time, and some are actually required to carry two observers allowing 24-hour coverage. Observers collect a wide range of data, including how much fish and what kinds of fish a vessel has caught, and relay this information to fishery managers on shore. They also note any unintended catch, or bycatch, of other fish or marine mammals. Scientists and fishery managers use this information to set catch limits, close fisheries, revise population estimates, and make other management decisions.

The current observer program is a system that satisfies no one. The validity of the data, high costs, human limitations, increasing scope, and labor considerations of today's program are becoming an ever more contentious issue both inside the industry and among groups along its periphery. Fishermen don't like the expense and the "big brother" nature of having observers aboard, the space observers take on their boats, and the risks associated with having non-crew working on deck. Observer costs in Alaska run between $250-300 per day, and the money usually comes out of the fishing crew's share. For their part, many observers feel they aren't paid enough and wish they weren't viewed as unwanted fish cops. Due to high turnover in the observer corps, observer companies increasingly face labor shortages and are constantly recruiting new employees.

Meanwhile, environmentalists and some people in regulatory agencies feel observer coverage is inadequate and want more.

The Solution

At the same time, technology has advanced rapidly on a number of fronts. It now appears that enough individual components already exist that some form of mechanized observer system is inevitable.

Examples of these components include:

- High-resolution digital cameras, like those, which capture images of speeding motorists and record both faces and license plate numbers.
- Several software programs, including ones developed in Alaska, Minnesota and Scotland as well as other places such as New York and Israel, that can identify images of fish, determine species, and in some cases provide accurate estimates of fish weight and length.
- The GPS system, which provides accurate location and time data anywhere on earth.
- Vessel monitoring and electronic logbook systems that use GPS data and modern ship-to-shore communications links.
- The latest generation of desktop computers, which can perform more than one billion calculations per second and only cost about $1,600 each. That means the average person can now own a certifiable "super computer," something which only ten years ago would have been unthinkable.
- A camera- and GPS-based vessel monitoring system that has worked for years in Canada's offshore sablefish fishery.

By combining these hardware elements, and building on an already-developed fish identification software template, we believe we can design a longliner-based observer system that will function as well as or better than humans do, and at a fraction of the cost.

We have good reason to believe we will be successful in our project. There is already a successful fish ID software system deployed at sea. As mentioned above, that system was developed over the past 10 years by a Scottish biophysicist working at the University of Aberdeen. Its purpose is to separate trawl-caught North Atlantic species aboard ship.

Observers perform two functions aboard ship: regulatory and biological. The former function involves assuring that the vessel crew is complying with the law while the latter function involves gathering data about the composition and volume of the catch.

As a finished product, the Digital Observer will duplicate those functions with separate but linked systems, each one fulfilling either the regulatory or the science role. Built to be tamper-proof, each shipboard system will consist of two or more cameras, a GPS, and a computer equipped with a large capacity hard disc and loaded with fish recognition, vessel monitoring, data summary, and communication software.

Consultants recommend video monitoring acceptance

In May 2000, the consulting firm MRAG Americas, Inc. released a final report titled, "Independent Review of the North Pacific Groundfish Observer Program." Tampa-based MRAG Americas was under contract to NMFS's Alaska Fisheries Science Center to assess the observer program's strengths and weaknesses and to recommend changes or improvements. One of MRAG's recommendations, found in section 3.4.2, was:

> "[Consideration should be given to] use of alternative approaches to monitoring fishing activity such as vessel monitoring systems (VMS) digital video surveillance, and the use of imaging devices with fish recognition software for automatic monitoring of species composition."

In December 2000 the International Pacific Halibut Commission issued a report it had prepared for NMFS titled, "A Feasibility Study that Investigates Options for Monitoring Bycatch of Short-tailed Albatross off Alaska." On Page 29 the authors conclude and recommend the following:

> "A video and GPS-based system has high potential for nearly complete monitoring of the short-tailed albatross mortality in the Pacific halibut fishery. Existing systems currently monitor fisheries for compliance with regulations. Determining if existing systems have the sufficient accuracy to monitor short-tailed albatross bycatch will require working closely with developers of the video systems. Adult short-tailed albatross and Laysan albatross have similarities in appearance, and juvenile short-tailed albatross and black-footed albatross have similarities in appearance, that may be hard to distinguish for birds brought up on hooks after hours on the ocean bottom. Some technical problems also need addressing. The system must assure that fishers cannot cut gangions or otherwise release a seabird out of view of the camera. A cut gangion could occur in the time of a one-frame blackout of the video system. Can a video system detect such a short-term obscuring of the camera? A video system has clear advantages in cost and ease of logistics over other methods, if developers can assure adequate accuracy and preclude fishers from preventing the camera from seeing the catch. We believe that developers may improve video monitoring to a satisfactory level with advance notice and support from NMFS or FWS, over the time necessary for the NMFS and FWS to evaluate and recommend a monitoring system for short-tailed albatross, and proceed through the NPFMC process. ***We strongly recommend that NMFS, FWS, and the NPFMC actively pursue development of video monitoring.***" (Emphasis ours)

The current state of permitted longline video monitoring

A video camera system, designed to assure regulatory compliance only, is operational in B.C's offshore longline sablefish fleet. Fisheries scientists employed by Archipelago Marine Research, Ltd., of Victoria, B. C, coordinated its development. Canadian DFO officials say that after the bugs were worked out the video monitoring system has performed very well since 1995.

Equipped with a wide-angle lens and mounted on the vessels mast, the camera looks over the deck and surrounding water. It is connected by cable to a VCR housed inside a locked, rugged box. Also in the box are a GPS and a character generator. Using standard videotapes, the VCR takes one "snapshot" of the deck every 10 seconds. Imprinted on each snapshot are the date, time and location, courtesy of the GPS. The time-lapse photography allows a fishing trip of more than 30 days to be captured on one two-hour tape. Privacy and "big brother" issues are effectively blunted because the action on deck is speeded up by 300 times (a standard video camera takes 30 frames per second) and fishermen are little more than blurs. By reducing weeks of fishing to a two-hour tape, a shorebased official can certify the vessel fished legally.

Fishermen like this system because it is cheaper and easier to live with than having human observers aboard. They report the cost of observer coverage for a 30-day trip dropped from C$10,000 to C$2,000. Officials with Canada's Department of Fisheries and Oceans express enthusiasm for the system and support it.

Researchers at Archipelago recently developed a newer system that does away with the VCR and replaces it with a computer. In this case digital images--up to one per second--are sent directly to the hard drive. Each image has a date, time and location stamp. A concurrent program tracks such vessel activities as location, speed, heading and whether the hydraulic system is active. Those indicators can be used by a shoreside "observer" who has access to the hard disc to determine whether the boat was fishing or in transit. The observer can then jump to the image set he or she wishes to view.

Digital Observer's planned system enhancement

Developing the second system, designed to replace the observer's biological data gathering functions, is what this project is all about. In this case, a second camera will focus at the fish, not the fishermen. Figure 1 shows a 2000 experimental camera installation aboard a chartered longliner.

When the boat is at sea the computer will have inputs and sensors that will allow it to "understand" what is happening on deck. The system's GPS unit will continuously feed data to the computer, which will track the vessel's speed. A sensor connected to the vessel's hydraulic system will detect pressure changes indicating whether the hydraulics are engaged. Another sensor, or sensors, will be connected to the vessel's power block or drum, indicating whether the line haulers are in motion. When the proper criteria are met--low vessel speed, hydraulics on, deck machinery in motion--the computer will assume that gear retrieval has begun. It will then activate the fish observation camera.

There will be yet another sensor connected to the computer. This one will be a directional, low power metal detector mounted near the crucifier. Its purpose will be to send a signal to the computer for each hook that passes by.

After the haul is completed and the sensors detect greater vessel speed, coupled with inactive deck machinery, the computer will shut down the fish identification camera and stop counting hooks. The mast-mounted camera, however, will remain active throughout the cruise.

One of this project's greatest challenges is where to mount the second camera. Because observers are required to take periodic samples of every fish hooked, our proposed system must be able to do the same. On our cruises in 2000 we mounted our cameras directly over the fish chute. That positioning, however, did not allow us to account for fish that were shaken off at the roller. During our planned May-June 2001 cruise, we will experiment with 2 camera mountings. One will be located on the vessel's starboard stabilizer pole, which will be deployed outboard of the gear hauling area. The second will be an underwater camera that will be positioned on the rolling chock against the hull.

Regardless of where the second camera is ultimately positioned, during the gear retrieval process it will be activated all the time, with the computer constantly evaluating whether a fish is present. As each fish comes into view, the computer will capture a rapid-fire series of pictures. The images will then go to a computer loaded with image analysis and species recognition software. The computer will first select the clearest image and then send it along to the species recognition software for identification.

Co-located with the camera, and aimed at the fish, we could deploy a green laser fitted with a prism, which will split the beam into a grid. Each split-beam segment will be 10 centimeters from the others. Therefore each fish image captured will have at least two laser dots on the fish. We believe the computer can be trained to pick out those dots and use the known distance between them (10 centimeters) to estimate the fish's overall length.

Using NMFS and IPHC length-weight data, the computer will estimate each fish's weight. By observing every fish and counting every hook, the computer will be able to gauge CPUE. The computer will be linked to a GPS. A concurrent program in the computer will therefore note the location, date and time of each fishing event. The program will enter all the information in an electronic logbook. After the machine is through with the images, it will dump them, freeing up disk space. If the computer cannot identify the image , it will save it to a portable disk for later analysis. On a periodic basis the computer will use the vessel's communication system to transmit its data to shore in a manner acceptable to NMFS. When the vessel returns to port, observer company representatives will retrieve data for analysis in their offices.

In a perfect world the system could identify, "weigh" and count every fish and every hook the vessel hauls. But the world is not perfect. Although the computer will "observe" 100 percent of the fishing activity, it will not be able to keep track of everything. We recognize that this system will not work for every fish. There will certainly be times the fog is too thick, the seas too high, or the spray too dense for the machines to function effectively. However, human observers don't observe every hook hauled either. They take samples and extrapolate from there. Observers on many Alaska vessels are present only 30 percent of the time the boat is fishing. Boats under 60 feet have no observers at all. Just as humans have their strengths (they can pick up a fish and examine it) they also have their weaknesses (they can't be on deck all the time). The proposed machine system will never sleep and during the course of a trip should be able to provide as much or more data than the humans do.

Digital Observer software developments to date

In 2000 Project staff collected multiple digital images of more than 14,000 individual fishes. Additionally we videotaped more than 90 hours of longline gear retrieval. Over the winter of 2000-2001, project software engineers developed the "alpha" version of a computer program that allows a computer to identify fish by species. The following pages discuss the software development process.

Continuous image flow from the camera the computer required the development of fish/no fish/new fish detection logic (see Figure 2). If there is no fish present, no further action will be taken. If a fish is present, then we will check system load logic. If the system is busy the image will be stored for later classification. If the system is not busy, the image will pass through subset (audit) logic. If it meets the user determined subset specifications, it will be stored for later audit. In either case, if the system is not busy, the image is next sent to the segmentation / feature extraction / classification module.

To account for the motion of live fish (sablefish are particularly active) a series of images of each fish were acquired, processed, and classified. For each fish, the classification of the image in that series that the neural net rated as looking the most like one of our training images, was selected to be the correct classification.

Images that do not contain the entire fish or that contain the fish overlain by some other object, such as the roller man's arm, are not processed.

Segmentation is the process that separates the object of interest from other objects in the image. In this case, fish images are segmented from the larger photo and sent on for further processing (see Figure 2). This is the key step in any machine vision application. Due to the requirement to work in an uncontrolled lighting environment, our segmentation procedure is based on the hue plane of the hue, saturation, value color model combined with the blue plane of the standard red, green, blue (RGB) color model.

Our current segmentation routine works well under uniform lighting conditions. We are examining new technologies to extend it to non-uniform lighting.

After segmentation, the next critical step is feature extraction. The goal is to extract a set of measurement of the fish that are characteristic of the fish, are relatively independent of the age (size) of the fish, distinguish it from other species of fish, and can be reliably and consistently extracted. After examination of the data we have chosen the following morphometric and color features for classification purposes. We have normalized the morphometric features by the square root of the area of the fish.

1. Length
2. Length of the major axis of the ellipse that fits the fish
3. Perimeter
4. Eccentricity of the ellipse that fits the fish
5. Width of the fish at each 10% down the length (9 measurements)
6. Average hue of each cell in a 20 cell grid laid over the fish (shown in figure 3, 20 measurements)

Or

7. A 20 bin histogram of the hue of the entire fish.

This yields a total of 33 features that are input to the classifier. Both feature sets have been examined and the results appear favor the average hue of the 20-cell grid. The hue is used for the color measurement because it is independent of the intensity of the light.

For classification we have investigated the multi-layer perceptron (MLP), the probabilistic neural net (PNN) and the fuzzy min-max neural net (FMMNN). The edge at this time in terms of performance goes to the fuzzy min-max neural net. To train the nets, we used a subset of the fish that were landed. Aboard ship a trained observer identified and recorded individual fish by species, length, and weight were recorded. A training set of images of 100 fish of each species (if that many were logged) was selected. A testing set of five times that number of images selected from the additional images of those fish was selected to evaluate the accuracy of the classifier. The results of that procedure are shown below.

Table 1 Alaskan Leader Examples

	Actual									
Classified As	Arrowtooth	Dover	Grenadier	Pcod	Pollock	Rougheye	Sablefish	Shortraker	Skate	Sum
Arrowtooth	201	7	0	0	1	0	4	0	2	215
Dover	8	62	0	7	0	0	1	0	2	80
Grenadier	3	0	160	4	1	0	21	0	1	190
P cod	1	2	1	156	8	0	6	0	0	174
Pollock	1	0	0	3	18	0	10	0	0	32
Rougheye	0	0	0	0	0	100	0	37	1	138
Sablefish	12	0	7	1	14	0	197	0	0	231
Shortraker	1	0	1	0	0	59	3	157	0	221
Skate	0	5	0	4	0	0	1	0	91	101
Sum actual	227	76	169	175	42	159	243	194	97	1382
True Pos	89%	82%	95%	89%	43%	63%	81%	81%	94%	
True Neg	99%	99%	98%	99%	99%	97%	97%	95%	99%	
False Pos	1%	1%	2%	1%	1%	3%	3%	5%	1%	
False Neg	11%	18%	5%	11%	57%	37%	19%	19%	6%	

Total Pct Correct 83%

Listed across the top of the table is the actual species of the fish in the picture. Listed on the left side is the species that the neural net called the fish. At the bottom are the sums of the actual numbers of fish, while on the right are the sums of the classified results. The true positive, true negative and their complements are shown under the sum of the actual species counts. 83% of these fish were classified correctly. The total number of images per species is less than the 500 that were input (except for Dover sole and Pollock where we did not have 500 images to work with) because the fish in these images did not meet our classification accuracy standards, were contaminated by foreign objects, or did not contain the entire fish. This is the reason we take multiple images of each fish.

The step where only the highest classification for each fish is used has not been implemented for this classifier at this time, but will improve the final results.

On May 21, 2001 the F/V Kariel, a 66-foot sablefish longliner began testing the first version of Digital Observer software on a charter cruise out of Kodiak. The data gathering and software testing will end today, June 7. Preliminary data indicate that the software did not work as well aboard a working longliner as it did in the lab. However, we identified the bugs inside the software and believe that we have learned (and, as more data become available for analysis, will continue to learn) the source of the bugs. We are confident we can address the bugs and will be able to produce a working version of the software by the project's end.

Plans for 2001-2002

Over the next 24 months we will pursue the dual goals of regulatory acceptance and system development.

The hardware and software components of the system require more work to assure system functionality under diverse climatologic and lighting conditions. Camera placement, and the ability to account for fish lost or shaken off at the roller, will be of crucial importance. The fish identification software also requires more fine-tuning.

Our intention is to work closely with agencies, academics, and industry so our system will comply with regulator's needs.

The current observer regulations were written specifically for human observers with no allowance for the optional substitution of video or digital monitoring. That is because when observer programs were first introduced the type of advanced technology we have today was not available. We believe video or digital monitoring system will eventually come to Alaska's fisheries and want to work with regulators to make that option available to the fleet.

Respectfully submitted

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Figure 1: Digital Observer Installation on the Kariel 5/00

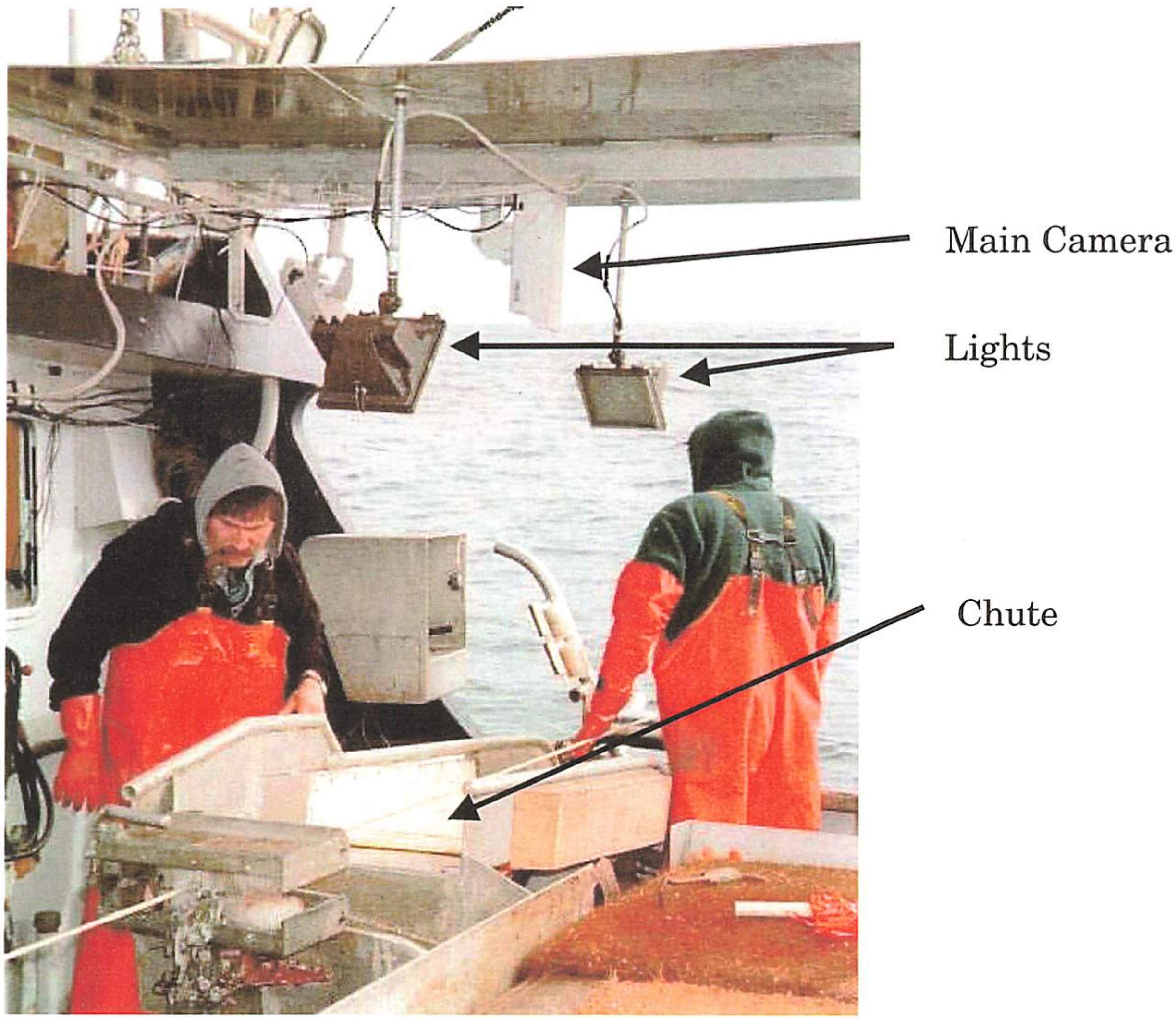


Figure2: Data Flow Diagram for the Digital Observer

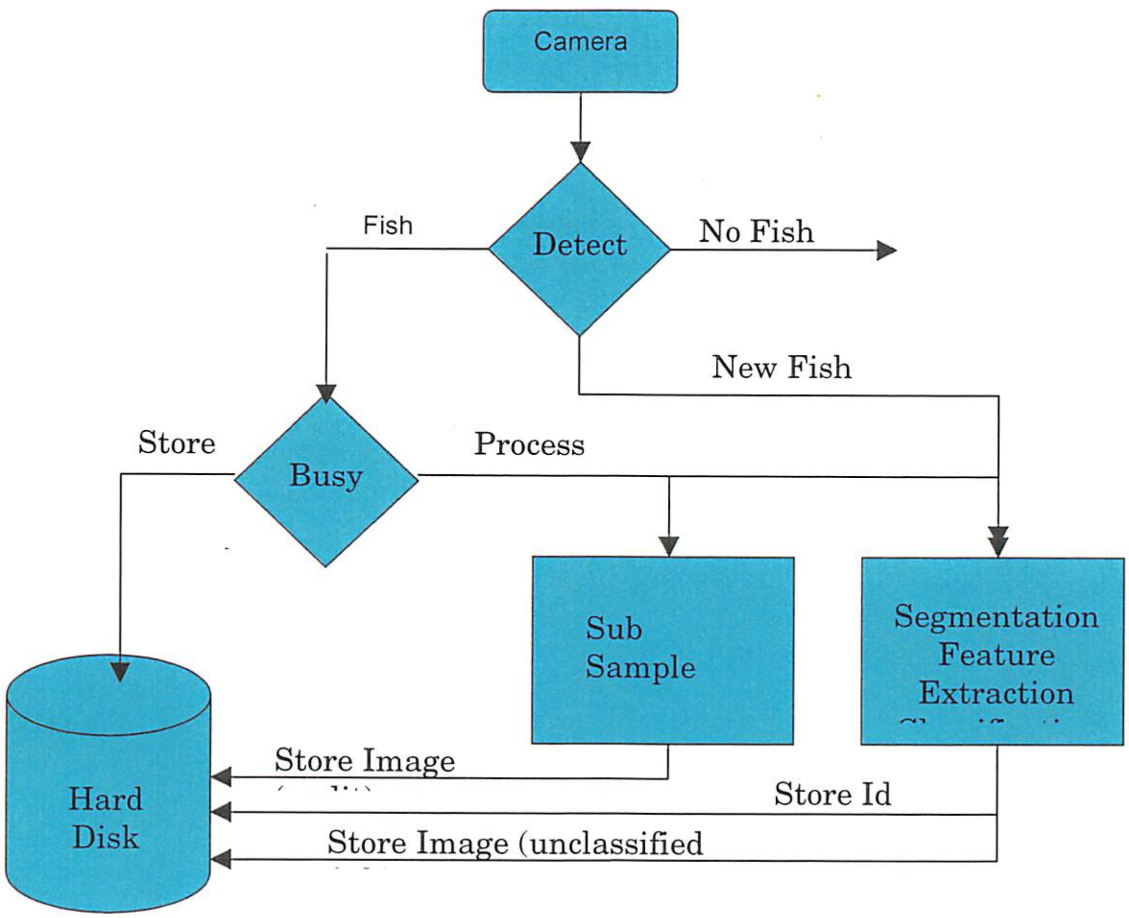
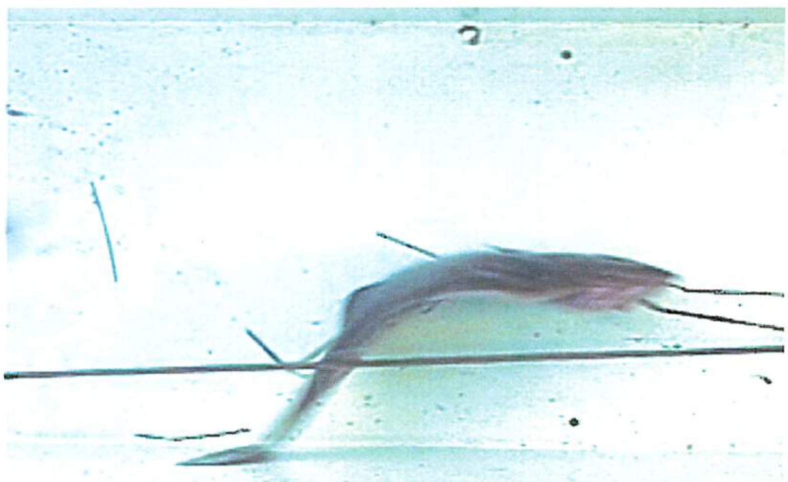


Figure 3 Demonstration of the advantages of multiple images of each fish for classification purposes. In the Digital Observer, an image is captured every 0.1 sec and the image with the highest classification probability (the one that looks the most like our training set) is assumed to be correct.

What species is this fish?



This is the same fish

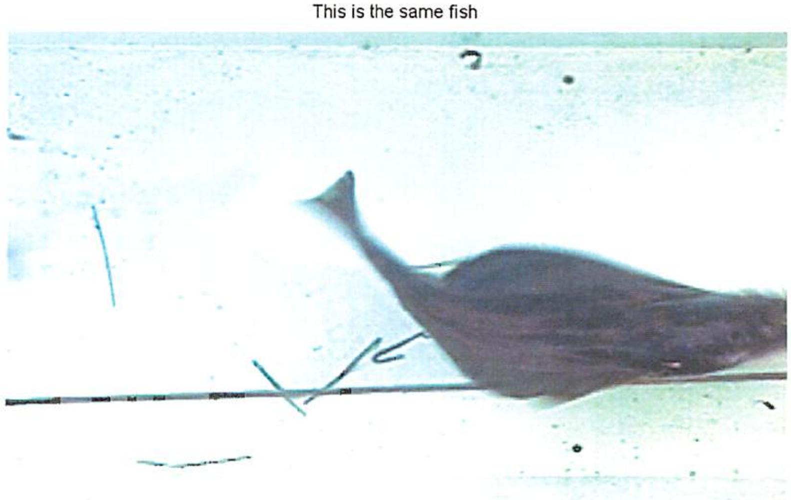
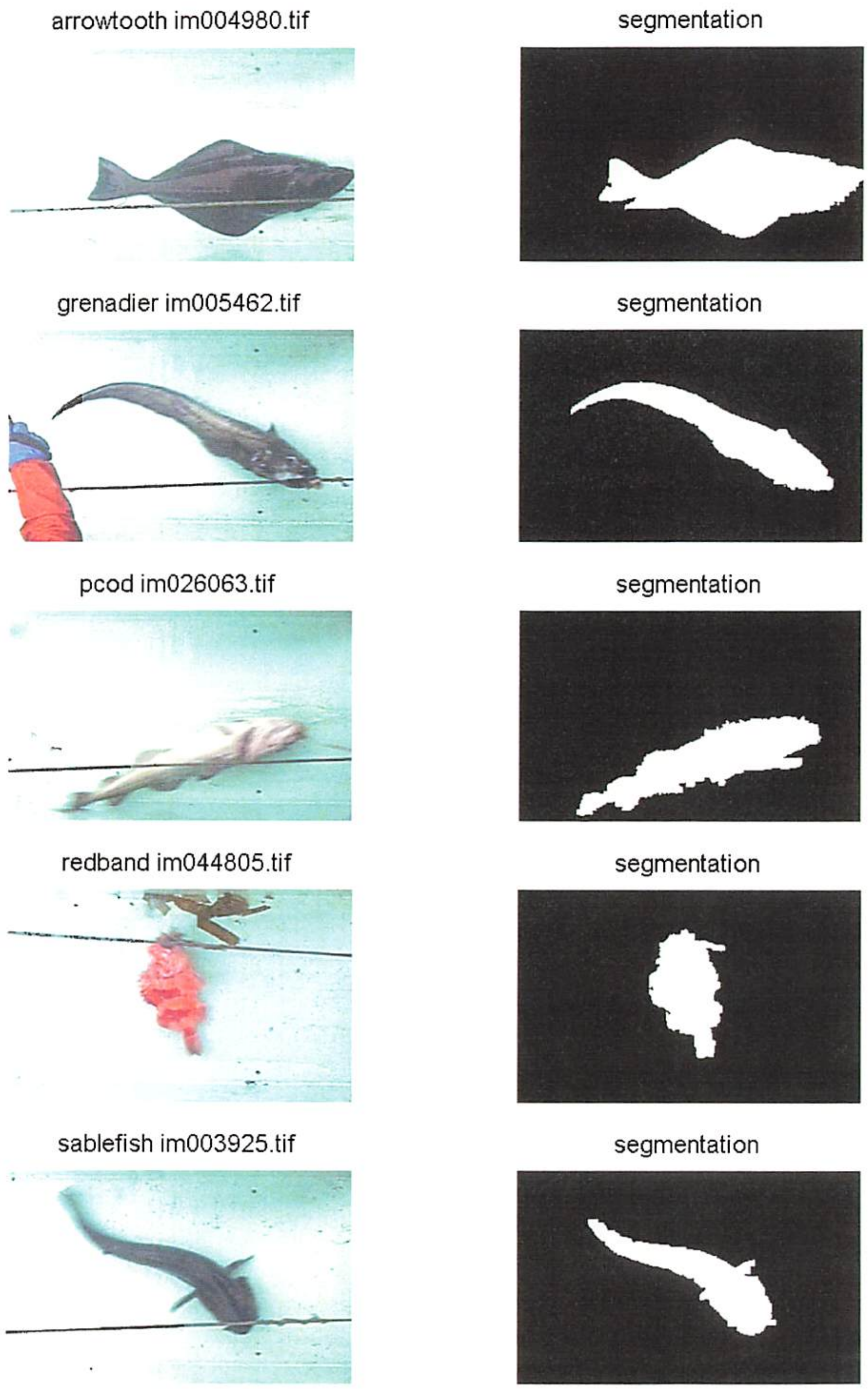


Figure 4: Example of image segmentation for various species.



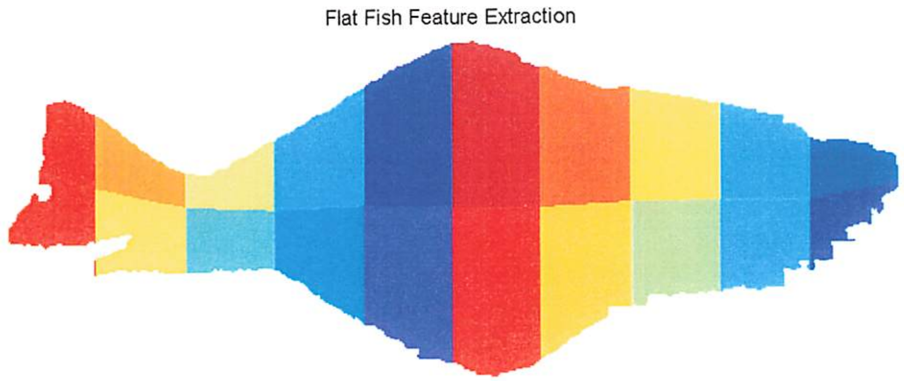


Figure 5a: Feature extraction for a flat fish. Note the 20-cell grid that is used to calculate the average hue metrics. The widths at each 10% of the length are measured along the boundaries to these cells. For flat fish the fish is rotated but assumed not to be curved. The length of the fish is measured along the horizontal line separating the grid cells.

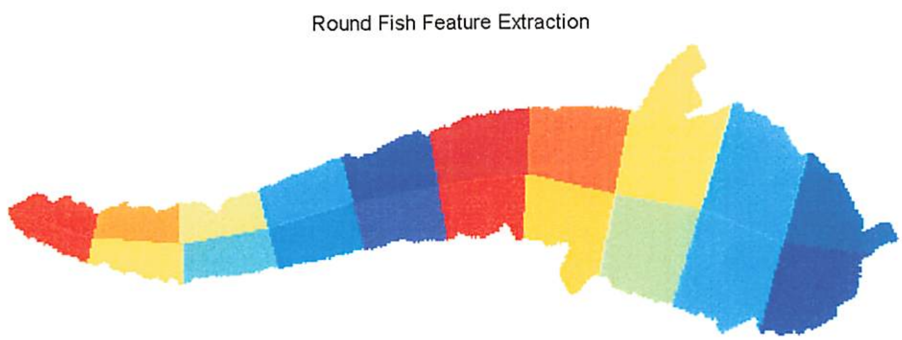


Figure 5b: Feature extraction for a round fish. Note the 20-cell grid that is used to calculate the average hue metrics. The widths at each 10% of the length are measured along the boundaries to these cells. For round fish the centerline of the fish is determined first, and the widths (cell boundaries) are measured perpendicular to that centerline. The length of the fish is the length of the centerline that separates the boundaries.