A view ABOVE ALL

News From Ocean Imaging Corporation — Volume 2 Issue 1

Winter 2004

It was a Busy Summer....

Welcome to our second newsletter. OI had quite an eventful summer, with two on-site projects in Alaska, as well as a variety of continuing research work at home, wetland vegetation mapping and coastal pollution monitoring in Southern California, and our traditional fishing fleet support throughout the world. We are very excited about a new NASA-funded project which will allow us to generate a first-time, worldwide map of kelp forests in the world's oceans as they existed in the year 2000. We will then use older and newer imagery to document long-term changes of these very important temperate reef communities. We have also restructured our company web site to better outline our various capabilities and keep up with new projects (see it at **www.oceani.com**). I hope you find this issue's articles interesting and, as always, invite you to contact me with any remote sensing needs you may have.

Sincerely,

jan@oceani.com

Where have all the SALMON gone?

Spawning Male Chinook Salmon

Salmon have been critical to the survival of people and wildlife along Alaska's western shores for thousands of years. Several species of salmon regularly migrate from the Bering Sea into Alaskan rivers and streams where they give birth to future generations. In the past decade returns of salmon have been in decline throughout the AYK Region. During the 1997 and 1998 seasons salmon returns suffered a catastrophic drop to only a fraction of their previous populations. As the result, severe restrictions or all-out closures were put on commercial and subsistence fisheries throughout western Alaska and many regions have been repeatedly declared disaster areas by federal and state governments.

The obvious question is what caused the fish to disappear and what can be done to remedy it? OI is working on a state-funded project to help find the answer. Specifically, our objective is to process and examine a multi-decadal satellite data time series to establish if any environmental changes caused or contributed to the salmon declines. Ocean environmental influence is only one possibility. Other suggested causes include overfishing by multinational fleets while the fish are on the high-seas, predation, and poor juvenile recruitment due to some changes in the fresh water streams where they hatch.

OI is analyzing imagery from the AVHRR, SeaWiFS and MODIS satellite sensors. It is now well known that a very unusual phenomenon occurred in

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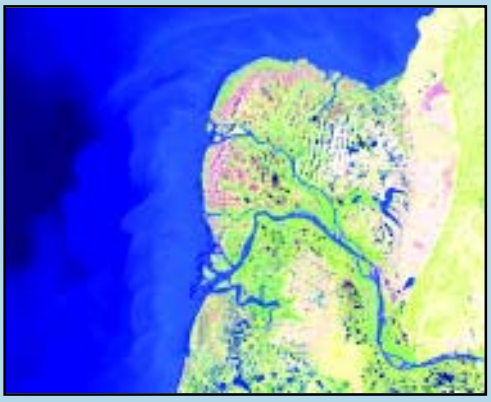
CONTEST:

Where in the WORLD *are we?*



The satellite image above shows the final few miles of one of the world's greatest rivers. Her total length is 3185km and her history is rich in adventure. She figured prominently in a famous 1897 gold rush, later relived by Charlie Chaplin in one of his films. She is an important feature in one of OI's present research studies.

First 5 persons who correctly identify the river will win an Ocean Imaging poster!

E-mail answers to kristen@oceani.com

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OI's Alaska Projects Continue

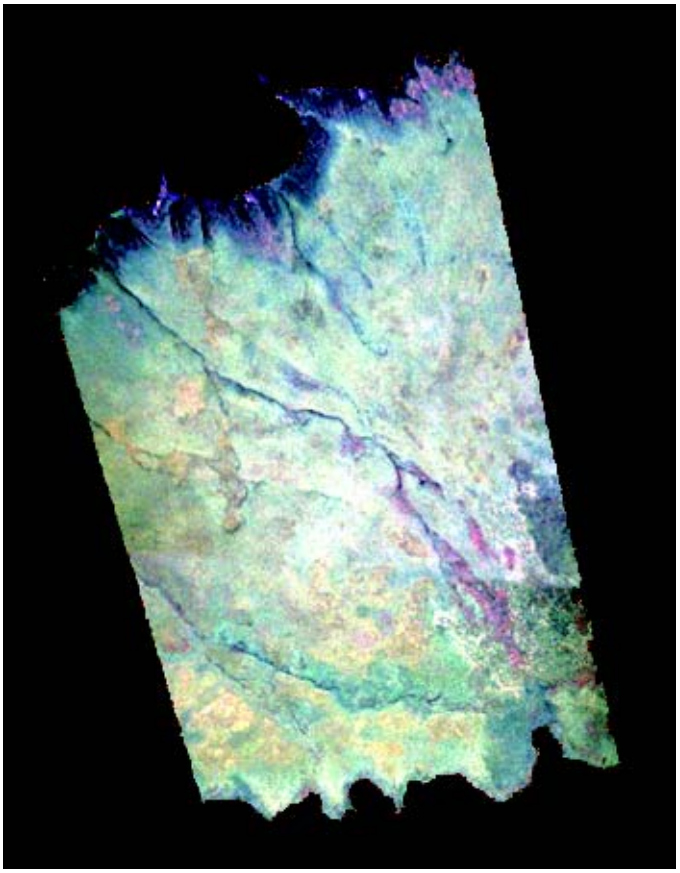
"The Goose" lands on a Unimak meadow.

It was a busy Alaskan summer for OI. In July we conducted a second year of research in Southeast Alaska. That project's objective is to develop a rapid means to estimate the existing biomass of kelp seaweeds for the Alaska Dept. of Fish and Game. The ADFG will use those estimates to establish harvest quotas for the kelp harvest industry. Several upstart companies in Alaska are using kelp in the production of organic potting soil and plant growth enhancers. During 2002 we developed algorithms for estimating kelp biomass from multispectral imagery obtained with our DMSC aerial scanner. This summer we refined the algorithms, and also documented the region before and after a local harvesting operation. Weather was much more cooperative than last year, so there was also plenty of time for fishing, crabbing and hiking. As always, fishing for salmon was great although we had to keep an eye out for the many whales that fed, slept and played in the same area. Our little skiff would not have fared well with an accidental tail or fluke flip.

In late August our DMSC was again deployed to Alaska, this time to the Aleutian Islands. The purpose of that project was to map vegetation on several small islands for an academic research team. Their studies involve the link in vegetation diversity and foxes. How can foxes affect plants? Before the 1800s only some of the Aleutian Islands had native fox populations. Then Russian and native fur trappers released foxes onto practically every spit of land in the Aleutians. The foxes multiplied, to the joy of the trappers but not the many birds that nest on the islands. The foxes' appetite for birds and their eggs altered the nesting patterns and densities on many islands, thus altering the spread of seeds the birds eat and the amount of guano fertilizer they produce. The islands OI mapped are some of the very few still left without fox populations and thus considered pristine, original habitat.

Successful aerial imaging in the Aleutians is highly challenging, to say the least. There is good reason why the region is called "The Cradle of Storms"! And if it doesn't storm it's usually foggy. Finding a suitable aircraft to work with is another problem. Our only option was a WW-2 era Grumman Goose operated by a local company. Seen only in museums in the lower 48, the flying tin can actually proved extremely agile. The fact that it can land on the ground as well as on water in winds as high as 35 knots (or more in an emergency) was another reason to love "The Goose".

The Aleutian Isles proved a harsh but also fascinating place



Aerial sensor image of part of Aiktak (a fox-free island in the Aleutian chain) enhanced to highlight different vegetation types.

and we took advantage of our new friendships with the brave local pilots to have them drop us off on a remote island with a giant live volcano – the Okmok Caldera on Unimak Island – and do a 12 day hike into the caldera. **By the way, Okmok on Unimak is the correct answer to the "Where in the World are We?" puzzle in our last newsletter!**

OI Recieves New NASA Funding

In late October '03 Ocean Imaging was awarded a $550,000 grant by NASA to generate a global map of kelp reef communities and study their vulnerability to changes. While considerable research attention is already placed on the effects of changing climate upon tropical coral reef habitats, there is practically no information on how global changes are affecting temperate reef communities. Many such habitats are dominated by kelp forests which are sensitive to changes in water temperature, turbidity and nutrient concentrations. Ocean Imaging will utilize a worldwide Thematic Mapper image data base processed by EarthSat Corporation to create a first-time global map of kelp reefs as they existed in the year 2000. This data base will then be used to compare with older as well as most recent regional data to quantify ecosystem changes in different world areas. This project fits well into NASA's present research emphasis on studying how the Earth is changing and what the consequences are.

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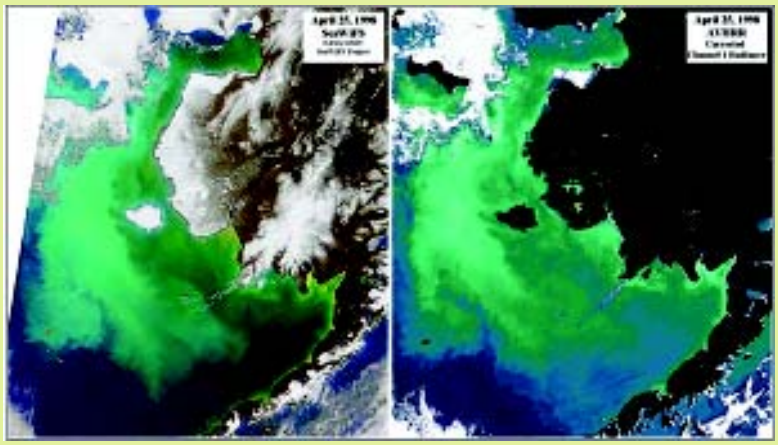
the Bering Sea during the summer of 1997. When the SeaWiFS sensor first began transmitting ocean color images in September 1997, scientists quickly noticed an extremely large body of milky blue-green water in the Bering, ascertained by field sampling to be an intense coccolithophore plankton bloom. The microscopic plants produce and shed calcite plates which cause the water containing an intense bloom to appear milky blue. Since no satellite ocean color sensor existed between 1987 and 1997 (except for a short-lived Japanese instrument), only occasional ship reports could be used in previous years to infer the absence of a similar event. OI utilized a technique to atmospherically correct AVHRR's visible channel and derive from it quantitative ocean color information. We were thus able to bridge the decade-long ocean color sensor gap and investigate what kind of events occurred before the big one in 1997. We found that smaller blooms did occur in some years prior to 1997 but never of such magnitude and persistence. We were also able to fully document the starting location and spread of the 1997 bloom which began in early July – well before SeaWiFS was launched. We are now examining correlations between fish abundance data and patterns of the blooms, sea surface temperature and satellite-derived currents. Our initial results suggest that the abnormal bloom (which reoccurred for several years after 1997) played a major role in the drastic salmon decline.



Coccolithophore bloom in the eastern Bering Sea on 4/28/98 as imaged by SeaWiFS (left) and specially processed AVHRR visible data (right). Note how well the AVHRR results match the color sensor's data.

The relation of the coccolithophore bloom to the salmon's demise can have several causes. Earlier changes in the Bering Sea in 1997 caused a depletion of more nutritious types of plankton and hence a reduction in larger plankton-eating organisms that are, in turn, prayed on by salmon. Many fish may thus have starved to death. The physical barrier of the milky, turbid bloom may also have caused the fish to alter their migration patterns and arrive late (or never) at their rivers to spawn. The good news is that the phenomenon has abated in recent years and the salmon populations are slowly increasing again.

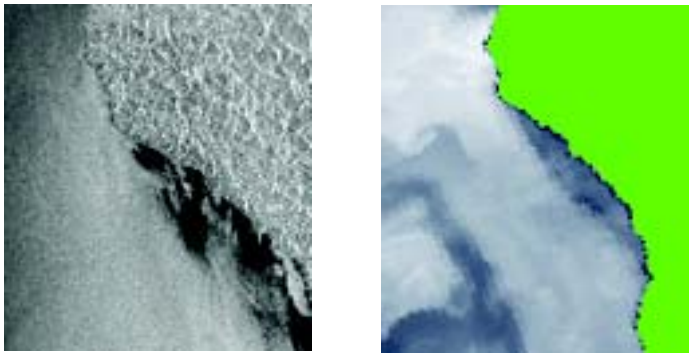
It's Tough Being a Sea Urchin

Urchin larva seen through a microscope

Since 1998, OI has been a part of the NE Pacific Global Ocean Ecosystem Dynamics (GLOBEC) research program. Supported by the National Science Foundation, OI has acquired and processed over 27,000 image sets of the N. American west coast from NOAA's AVHRR satellite sensors. The data archive, dating back to 1990, is stored on a server at Oregon State University through which the data are available to the broad scientific community (see http://coho.coas.oregonstate.edu/). In addition to providing this data series, OI researchers are using various satellite sensors to study how meso- and small-scale processes along the coast affect the populations of various organisms, including sea urchins.

Most of us think of sea urchins as those untouchable balls of needles. The truth is that they had a very tough time getting that way. Many marine invertebrates (urchins, crabs, barnacles, etc.) have a free-swimming larval stage before they metamorphose into their adult form and settle down. In "upwelling regions" such as along the U.S. west coast, they not only face the possibility of being eaten by other marine creatures, but many are also doomed when they become swept into deep waters by offshore–directed currents. Scientists have long recognized that age distributions in nearshore populations of invertebrates with pelagic larva stages tend to be uneven, sometimes with no adults at all surviving from a particular year. Since the larvae float around for 8 to 12 weeks or more, it seems amazing that any of them manage to outsmart the currents and settle in suitably shallow waters nearshore. Leading theories postulate that most of the larvae do get washed away by currents but some tend to be brought back either from offshore or other parts of the coast during episodes of upwelling relaxations.

OI scientists used a multi-year series of daily thermal images from the AVHRR sensor to study in detail what happens to water (and larvae) during active upwelling and upwelling relaxations at different locations along the coast. This information was then correlated with actual urchin larva settlement measurements collected by San Diego State University scientists. We found that



Study region south of C. Mendocino, California during larva settlement-favorable conditions. SAR image (left) shows nearshore aggregation of surfactants while AVHRR thermal image (right) shows narrow nearshore band of warm (dark-rendered) water, enhanced by warm freshwater outflow from several streams.

the previous theories do apply in some locations but not universally. In several regions they do not apply at all, because the very nearshore waters tend to be protected from steady upwelling or longshore currents and the larvae are thus likely retained there through their entire free-floating existence. OI researchers also utilized Synthetic Aperture Radar (SAR) data to document such regions' high aggregation of surfactant materials – another indication of retainment. Such protected reservoirs are likely very important for the large-scale survival of many invertebrate species along the coast. We are presently finishing a manuscript reporting our results for submission to the journal *Continental Shelf Research.*