Alaska CamSled

High
Resolution
Benthic Imaging

Gregg Rosenkranz
Ric Shepard
Ryan Burt

Kodiak, Alaska

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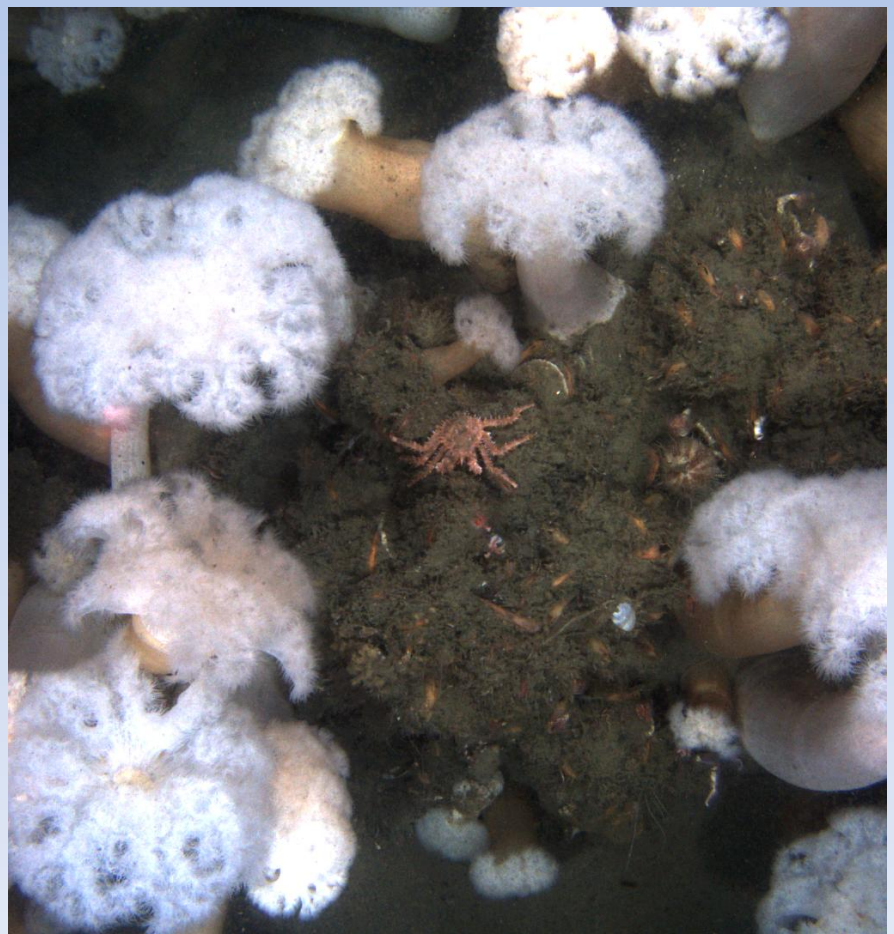
News > Science

The 20 big questions in science

From the nature of the universe (that's if there is only one) to the purpose of dreams, there are lots of things we still don't know – but we might do soon. A new book seeks some answers

The Big Questions in Science: The Quest to Solve the Great Unknowns
by Andre Deutsch

1 What is the universe made of?
2 How did life begin?
3 Are we alone in the universe?
4 What makes us human?
5 What is consciousness?
…..



16 What's at the bottom of the ocean?

Ninety-five per cent of the ocean is unexplored. What's down there? In 1960, Don Walsh and Jacques Piccard travelled seven miles down, to the deepest part of the ocean, in search of answers. Their voyage pushed the boundaries of human endeavour but gave them only a glimpse of life on the seafloor. It's so difficult getting to the bottom of the ocean that for the most part we have to resort to sending unmanned vehicles as scouts. The discoveries we've made so far – from bizarre fish such as the barreleye, with its transparent head, to a potential treatment for Alzheimer's made by crustaceans – are a tiny fraction of the strange world hidden below the waves.

Alaska CamSled

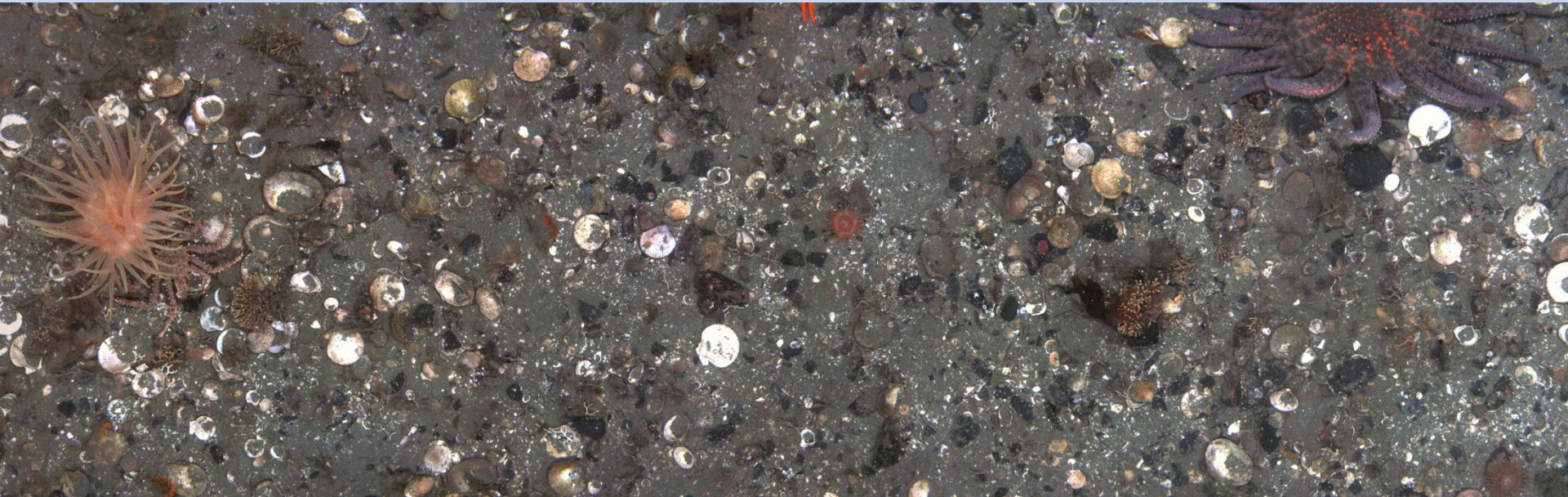
High Resolution Benthic Imaging

System Specs

- 1600 x 1200 pixel GigE Vision™ camera
- 6 xenon flashlamp strobes
- Gigabit Ethernet data telemetry
- armored fiber optic tow cable
- real-time monitoring/control
- 1 m-wide seafloor FOV
- 5 frames/sec, 40+ gigabytes/hr
- towing speeds 4+ knots

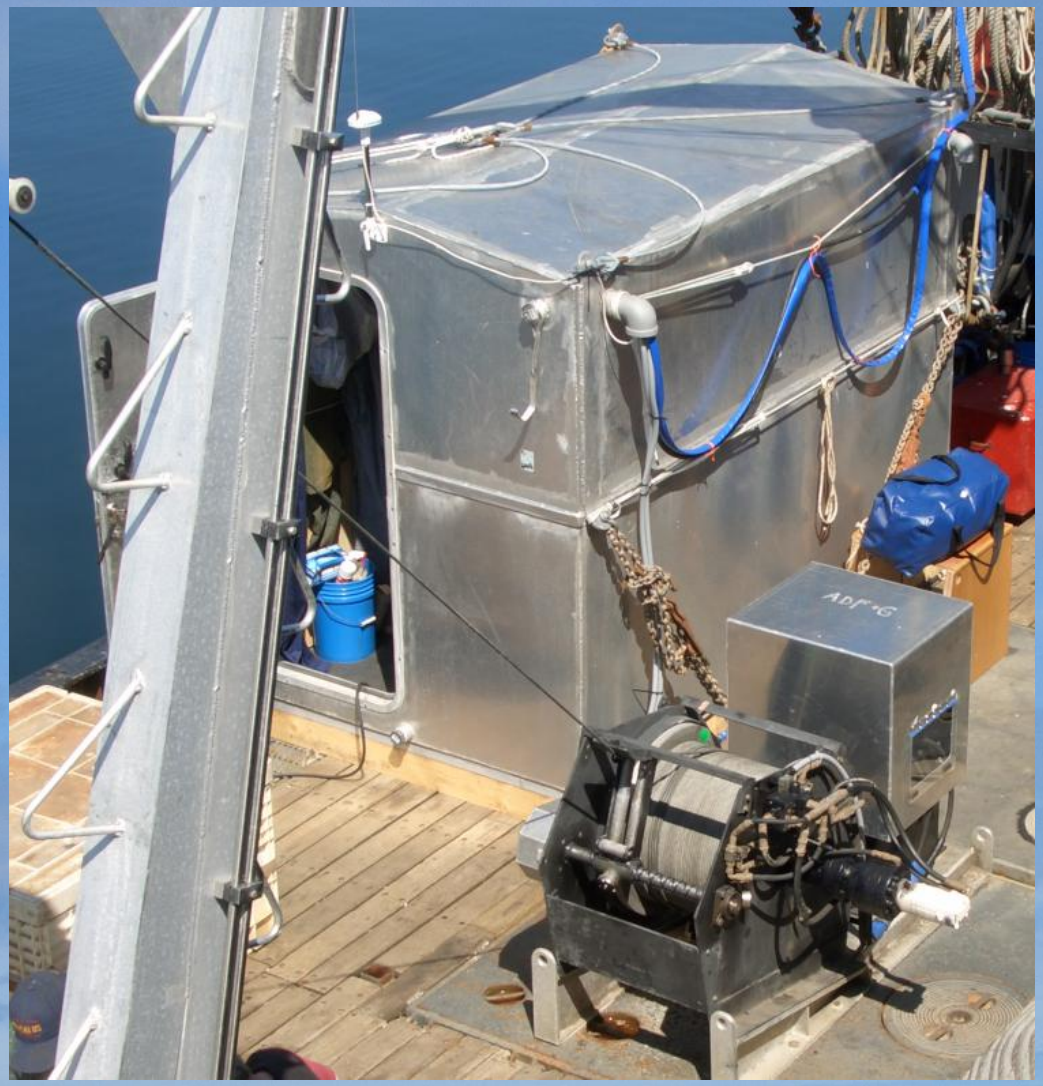
Over 2,000 km towed in the Gulf of Alaska and Bering Sea

Over 5 million images collected

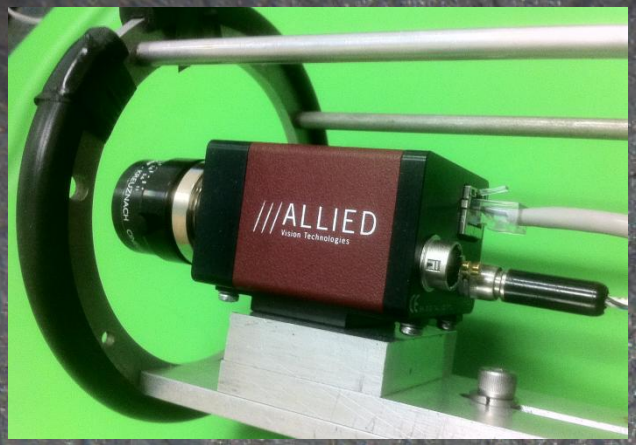


Why CamSled?

CamSled System Components

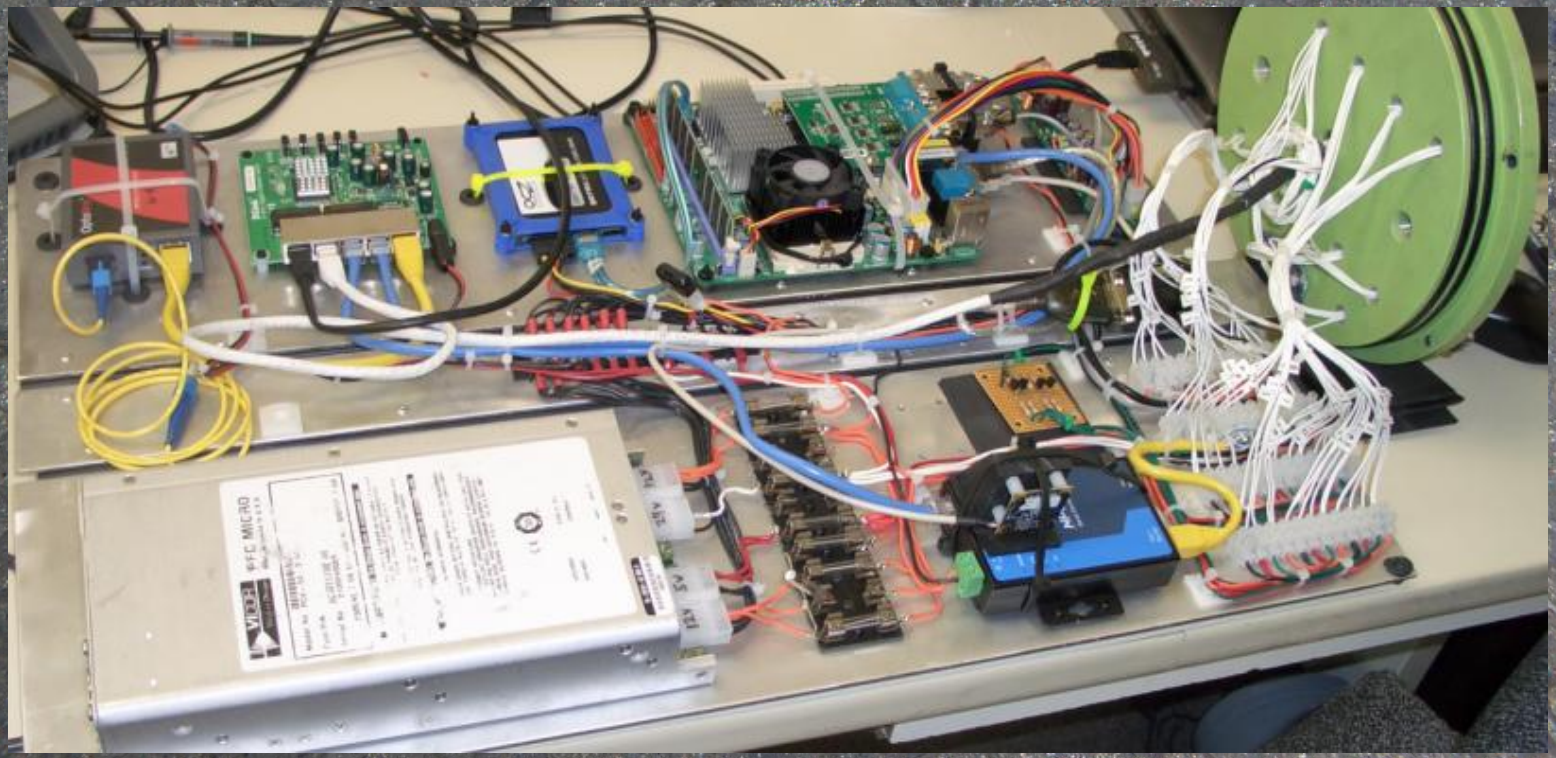


sled: 1605 lb
computer module: 3153 lb
winch/wire: 2663 lb



~~Prosilica~~
Allied Vision Technologies
GigE Vision Camera

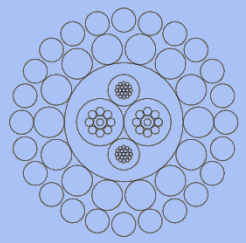
Ric Shepard
programmer/engineer



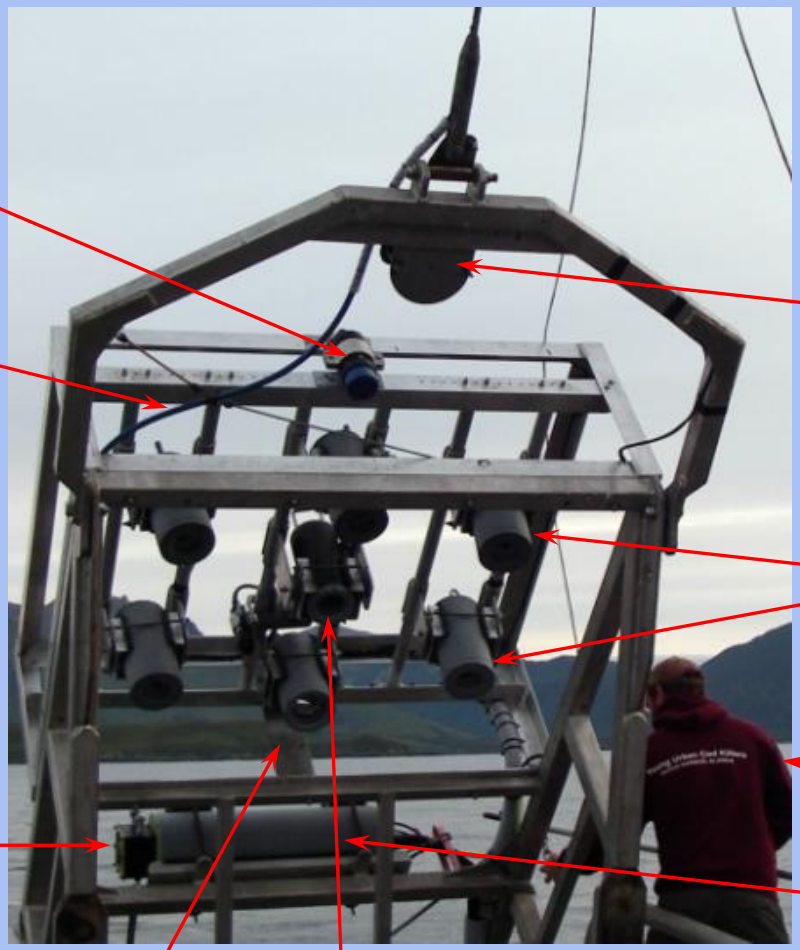
Telemetry
Bottle
Electronics

obstacle avoidance sonar

fiber optic cable



Rochester A305382
9.98 mm dia (0.393”)



pitch/roll sensor

~~Perkin-Elmer~~
Excelitas
MVS 5002
strobe lights

Ryan

oil-filled junction box

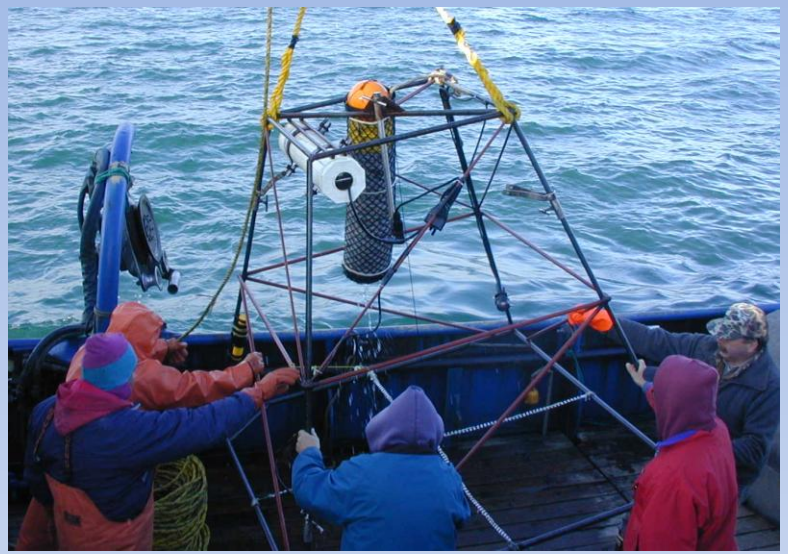
telemetry bottle

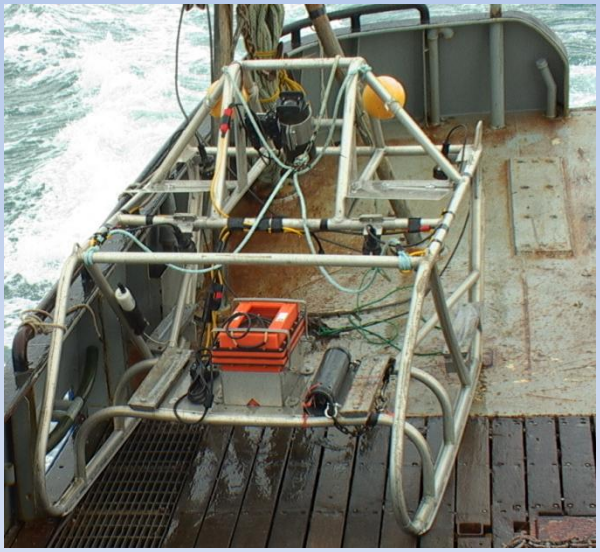
CTD

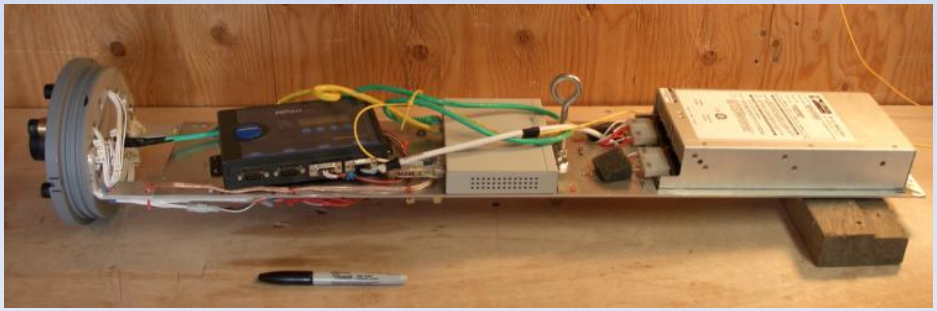
camera

Alaska CamSled
High
Resolution
Benthic Imaging

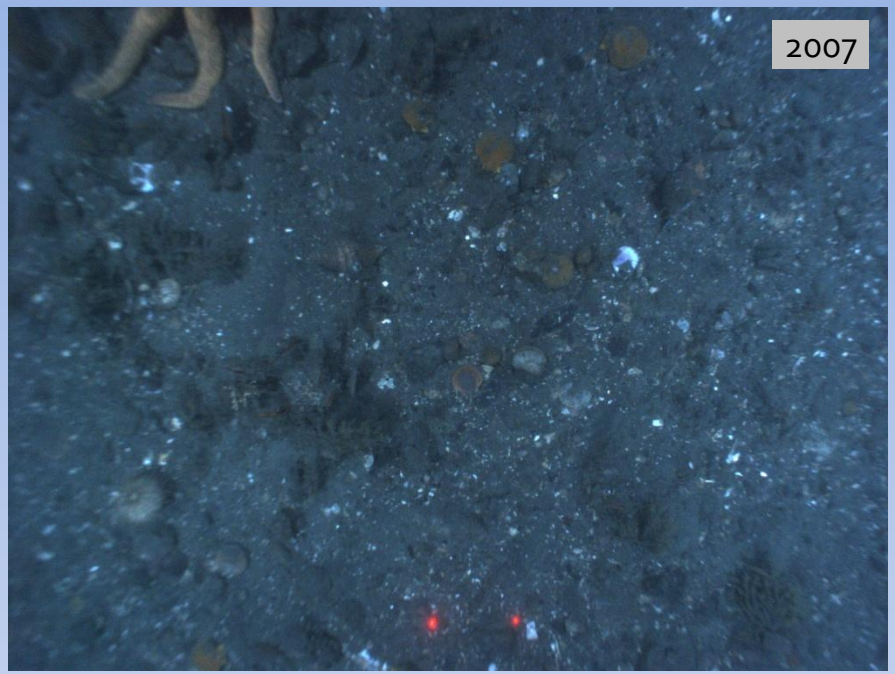
ADF&G Scallop Research
Underwater Imaging





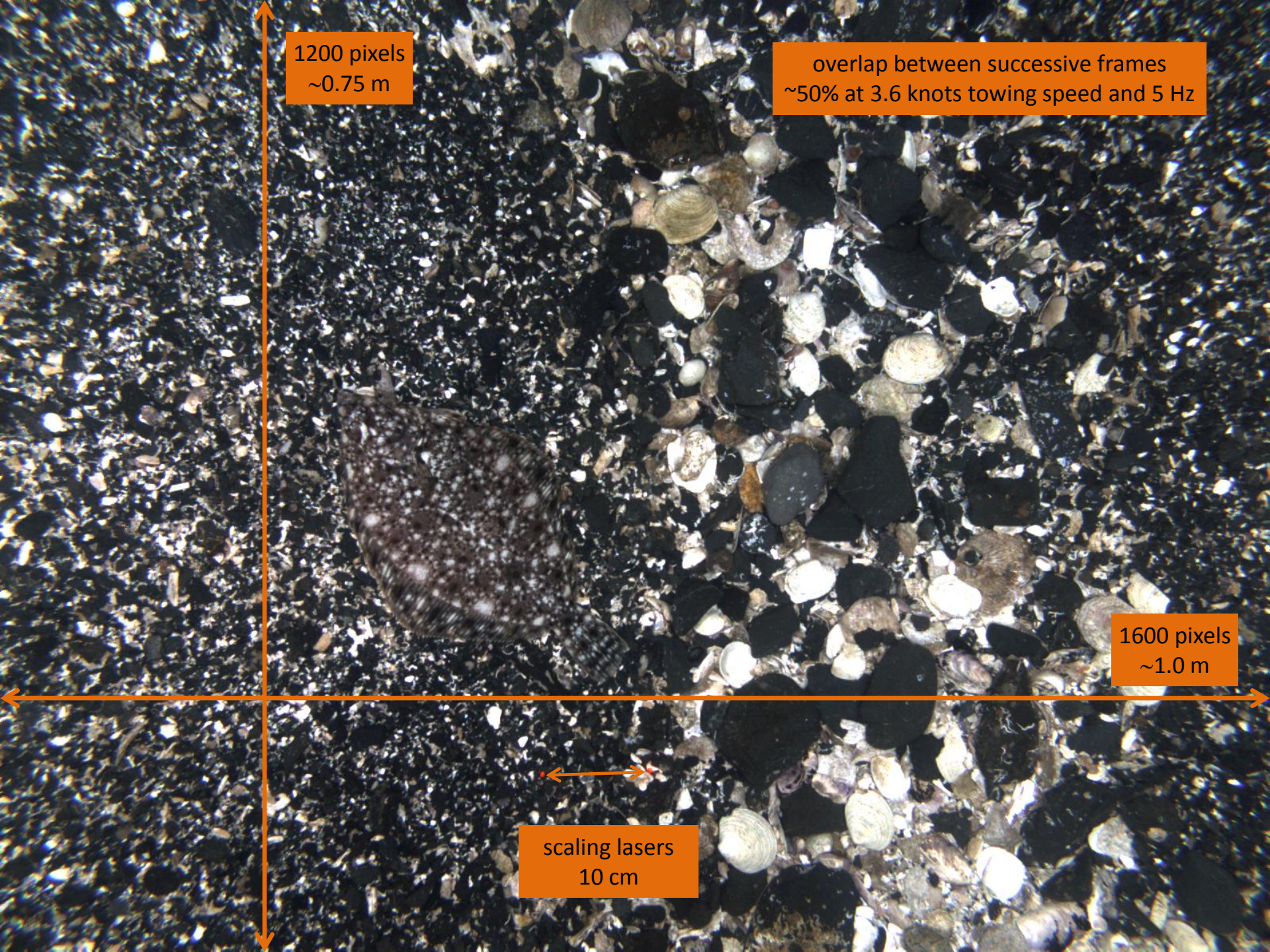


2002

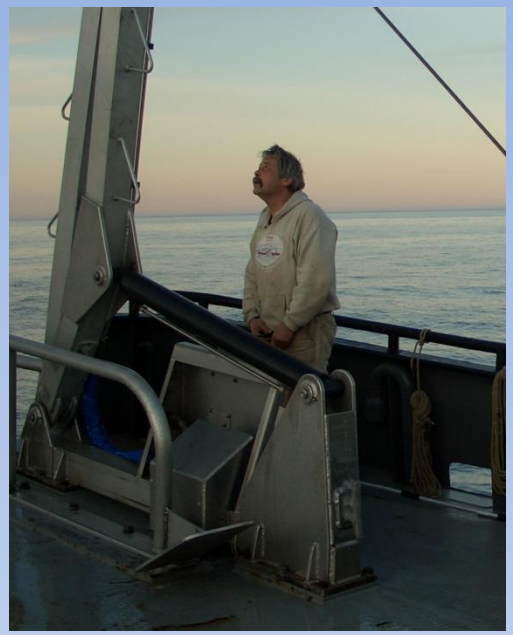

2007

2006

2012


1200 pixels
~0.75 m
overlap between successive frames
~50% at 3.6 knots towing speed and 5 Hz
1600 pixels
~1.0 m
scaling lasers
10 cm

RV *Pandalus,* Homer



Captain Mark Hottman

HabCam

HABitat mapping CAMera system

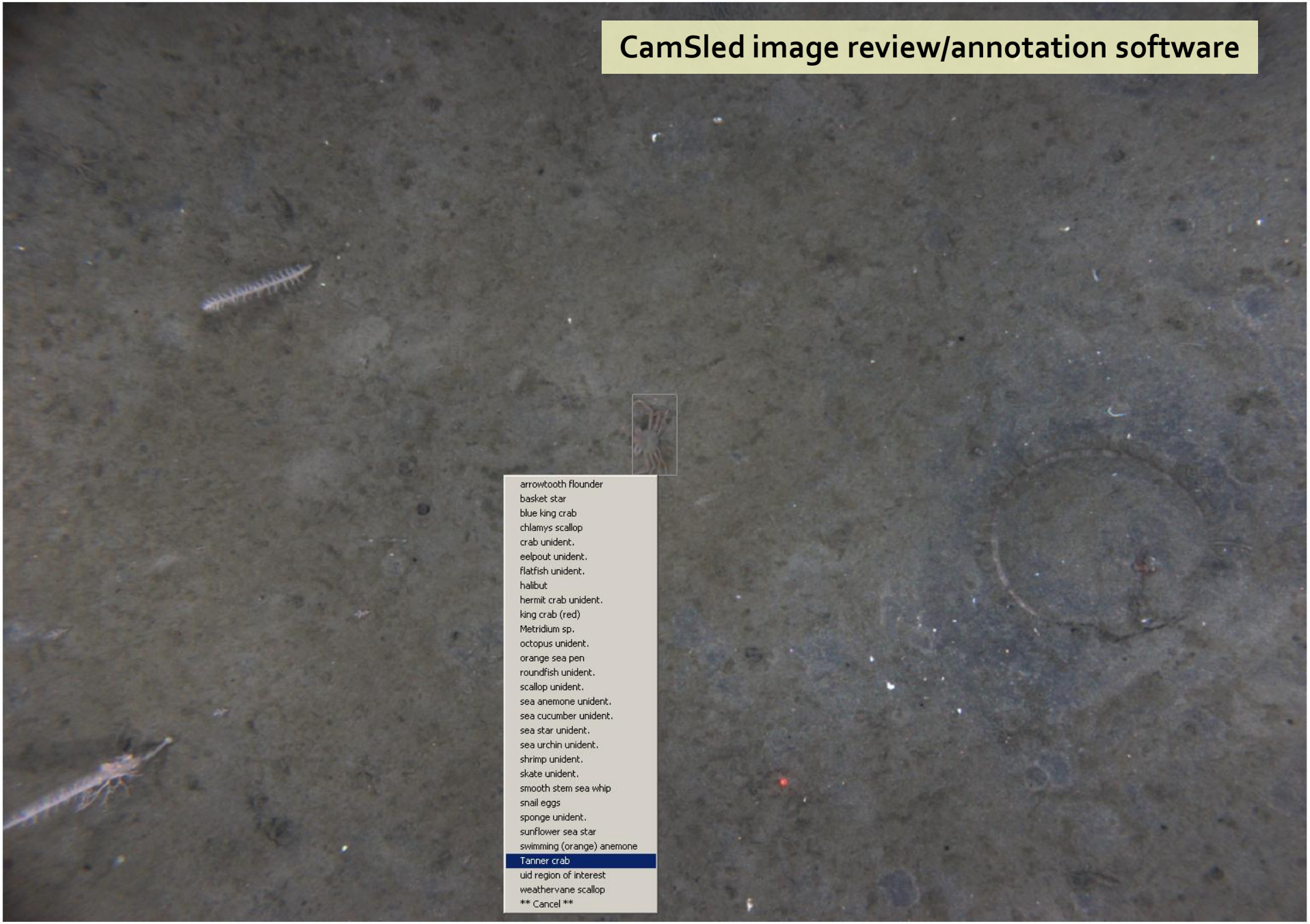
RV *Resolution*
ADF&G - Kodiak

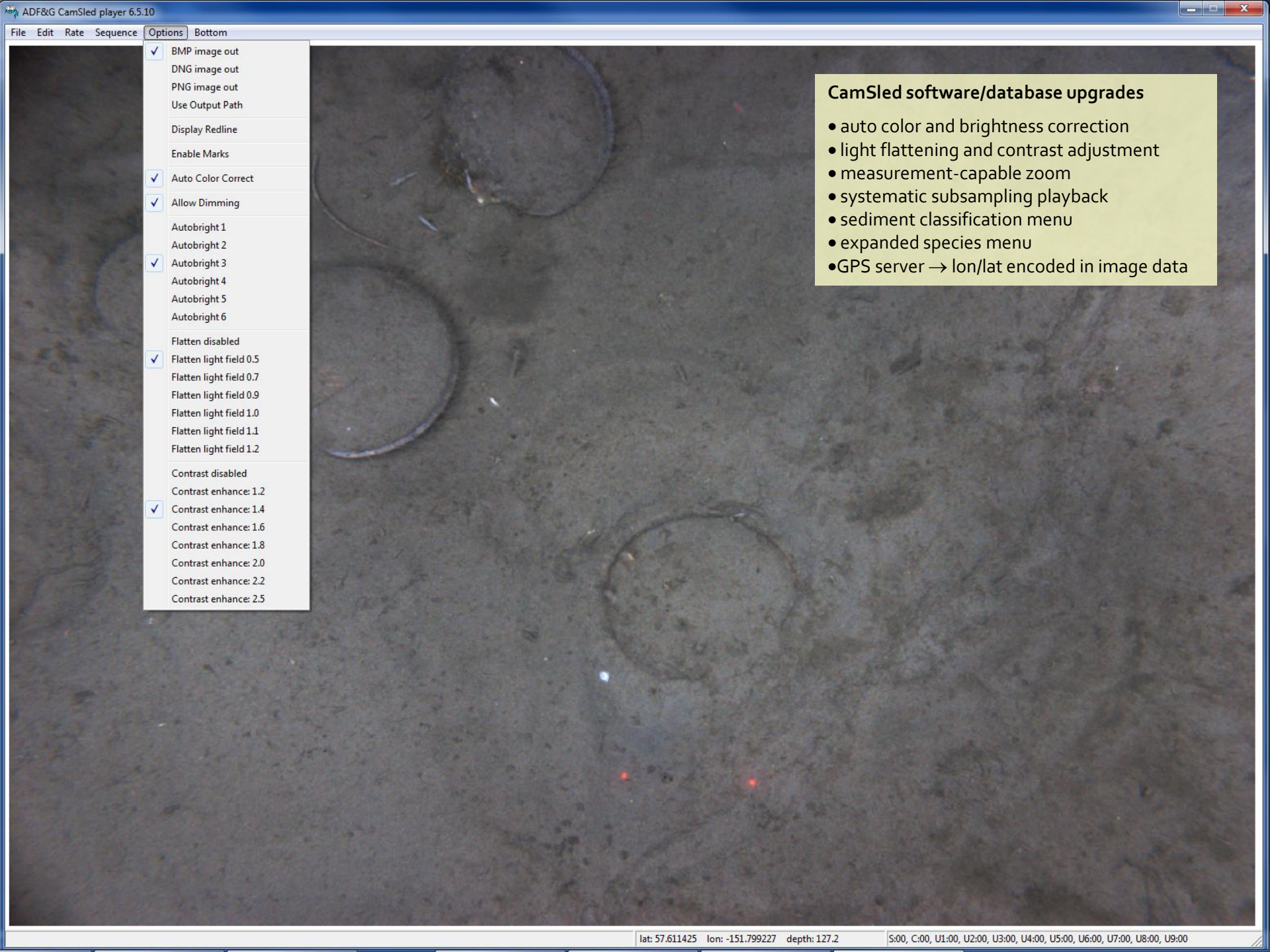
FV *Arctic Hunter*
commercial crab &
scallop fishing vessel

11/6/2013

FV *Provider,* Kodiak
potential 2013 survey vessel

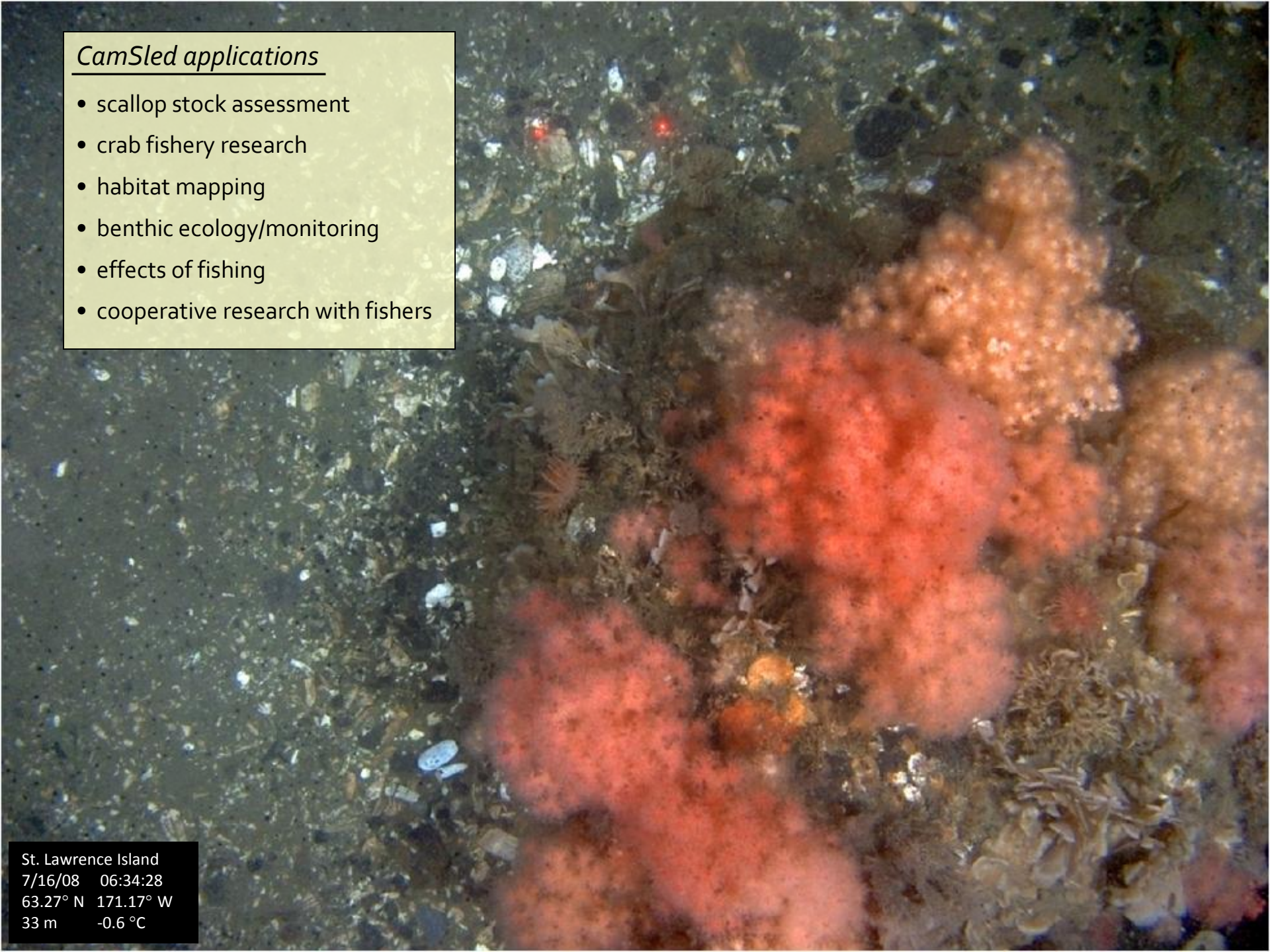
CamSled image review/annotation software





CamSled software/database upgrades

- auto color and brightness correction
- light flattening and contrast adjustment
- measurement-capable zoom
- systematic subsampling playback
- sediment classification menu
- expanded species menu
- GPS server → lon/lat encoded in image data

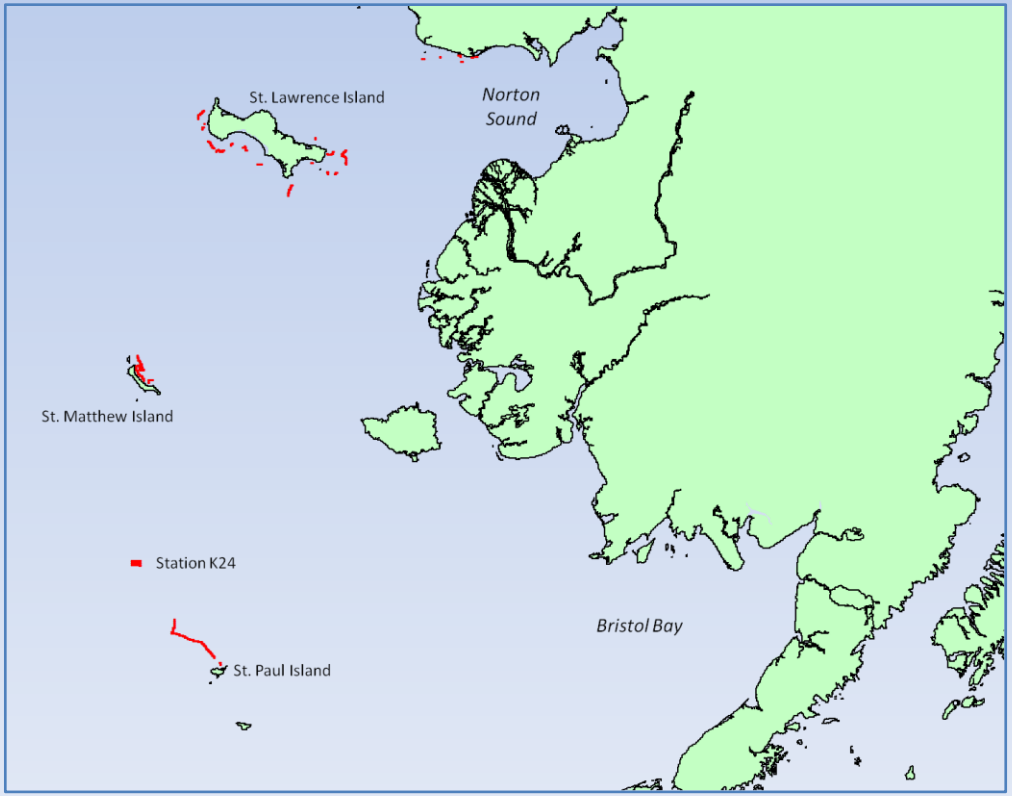


CamSled applications

- scallop stock assessment
- crab fishery research
- habitat mapping
- benthic ecology/monitoring
- effects of fishing
- cooperative research with fishers

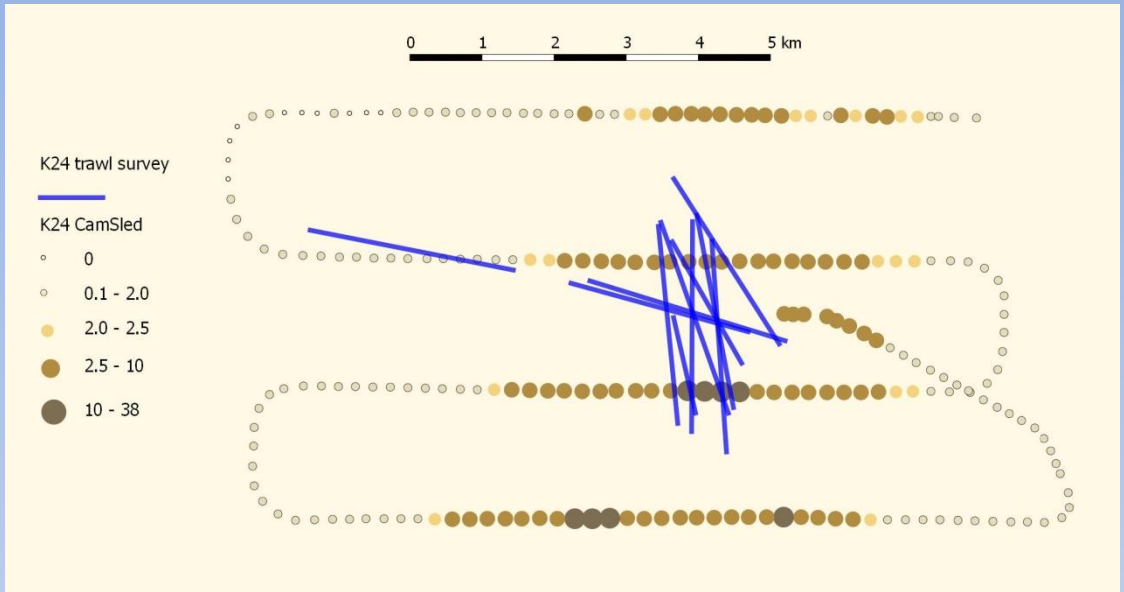
Bering Sea 2008
RV *Pandalus*

Alaska CamSled
High Resolution Benthic Imaging

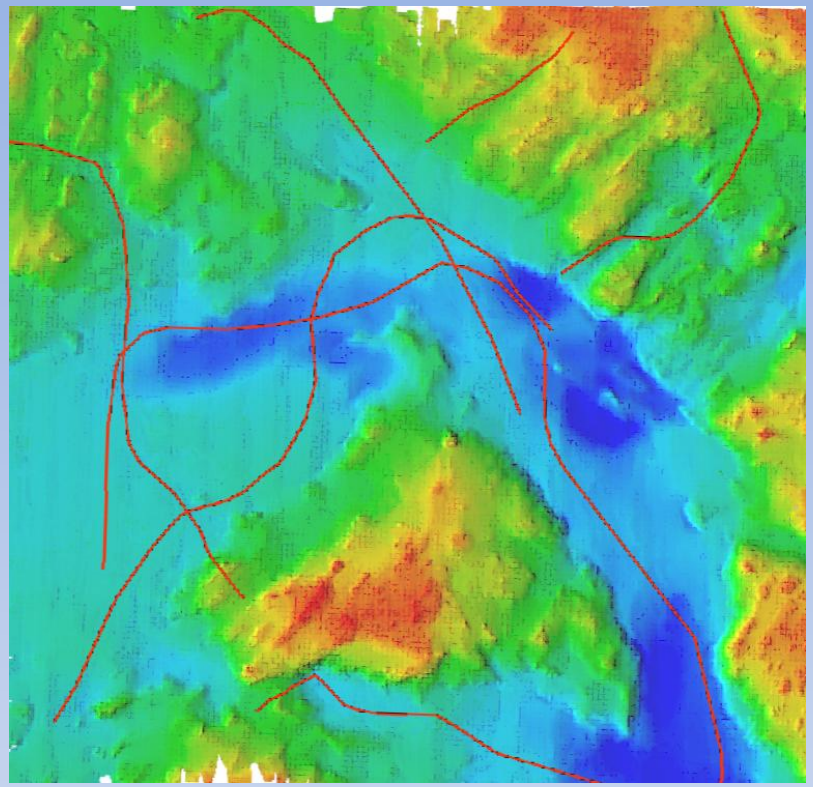


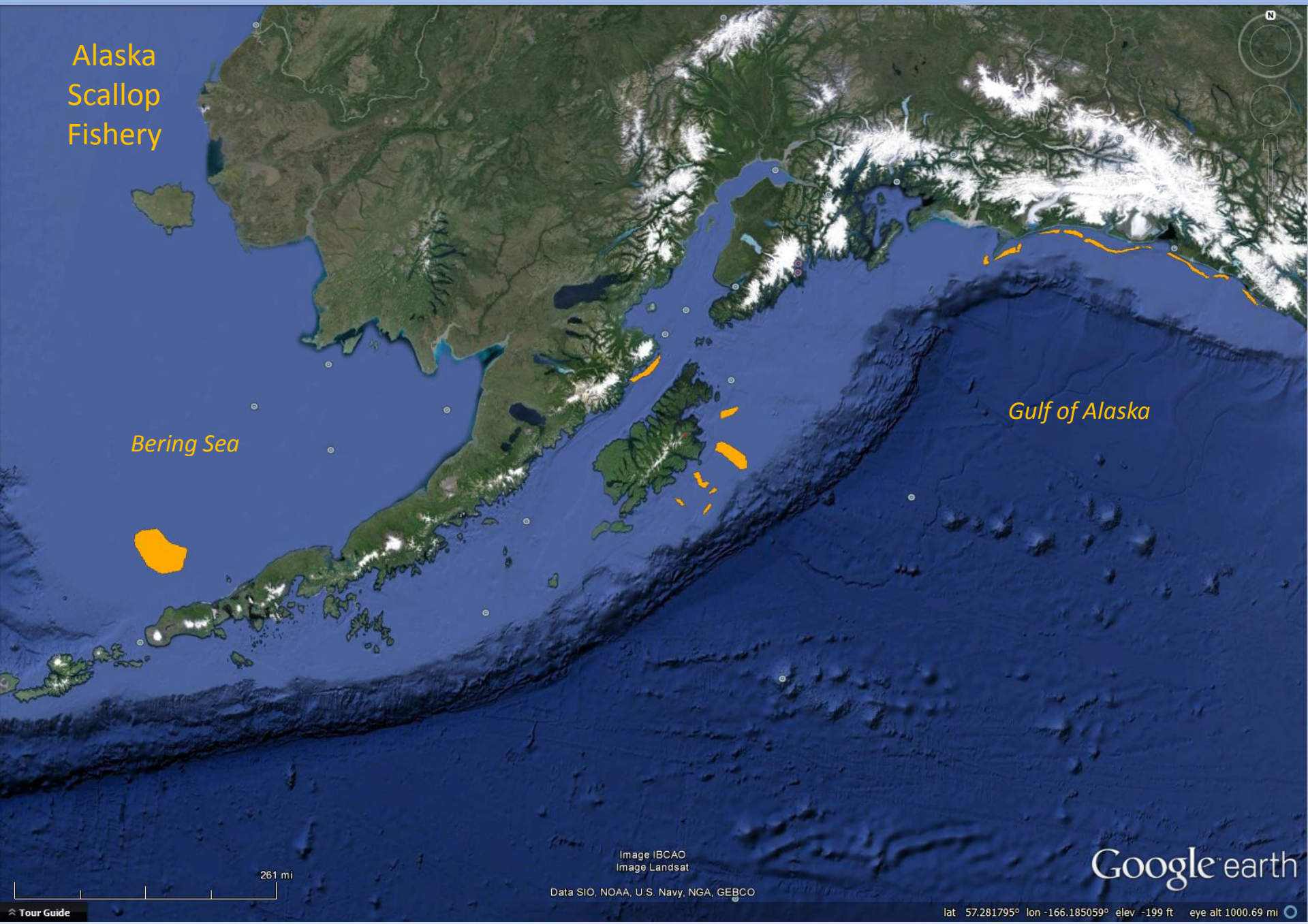
North of St. Paul Island
7/12/08 16:41:28
57.43° N 170.55° W
71 m 2.1 °C

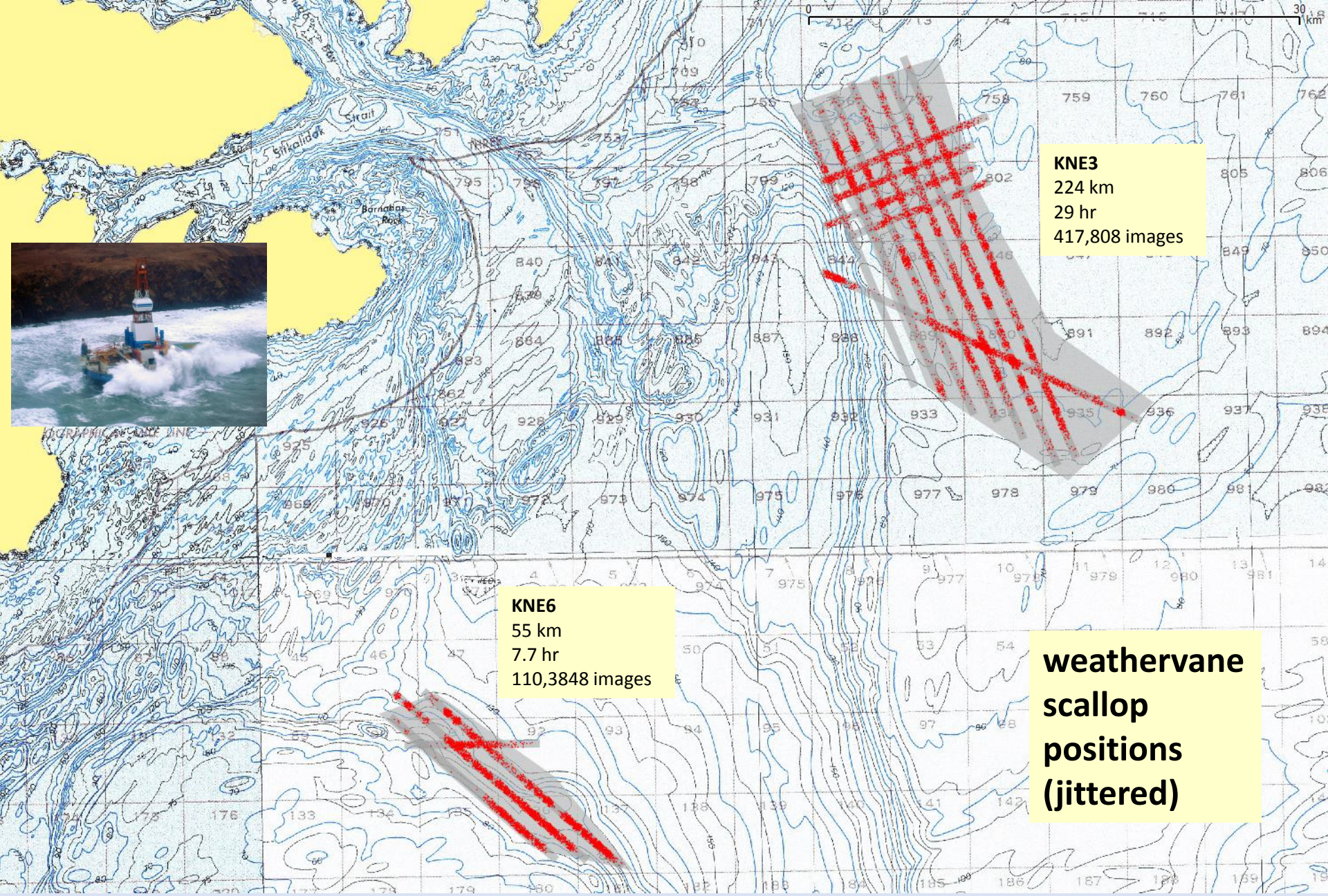
Bering Sea Trawl Station K24 Snow Crab

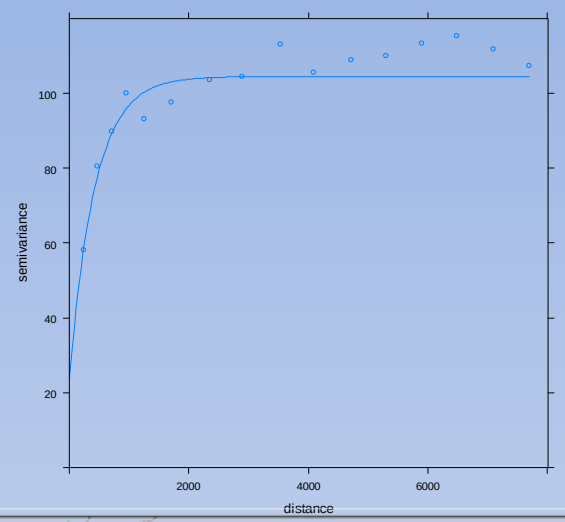


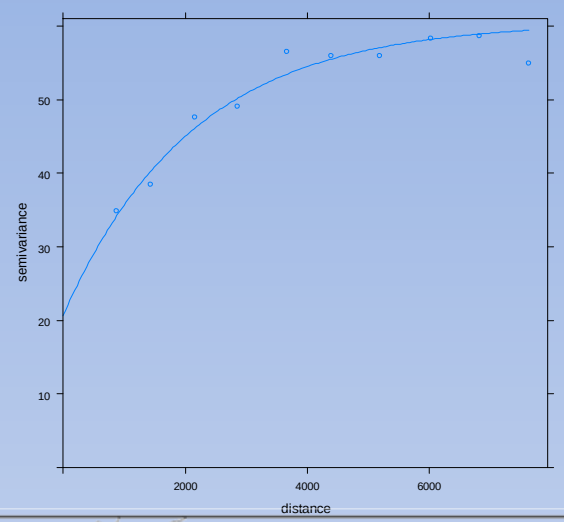
Kodiak Tanner Crab Habitat Mapping Project

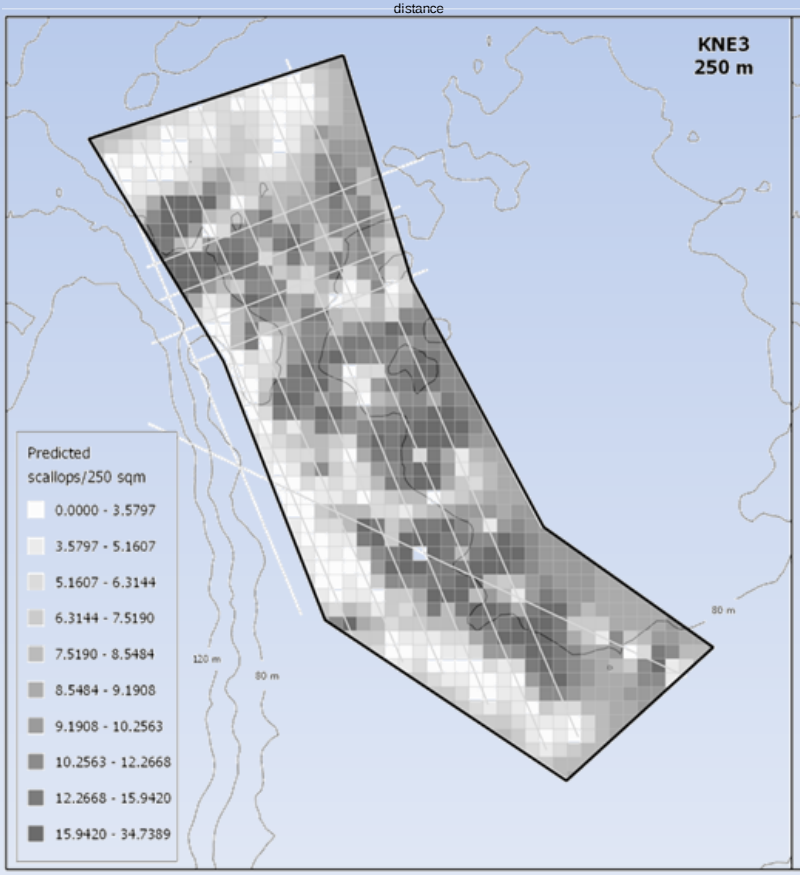


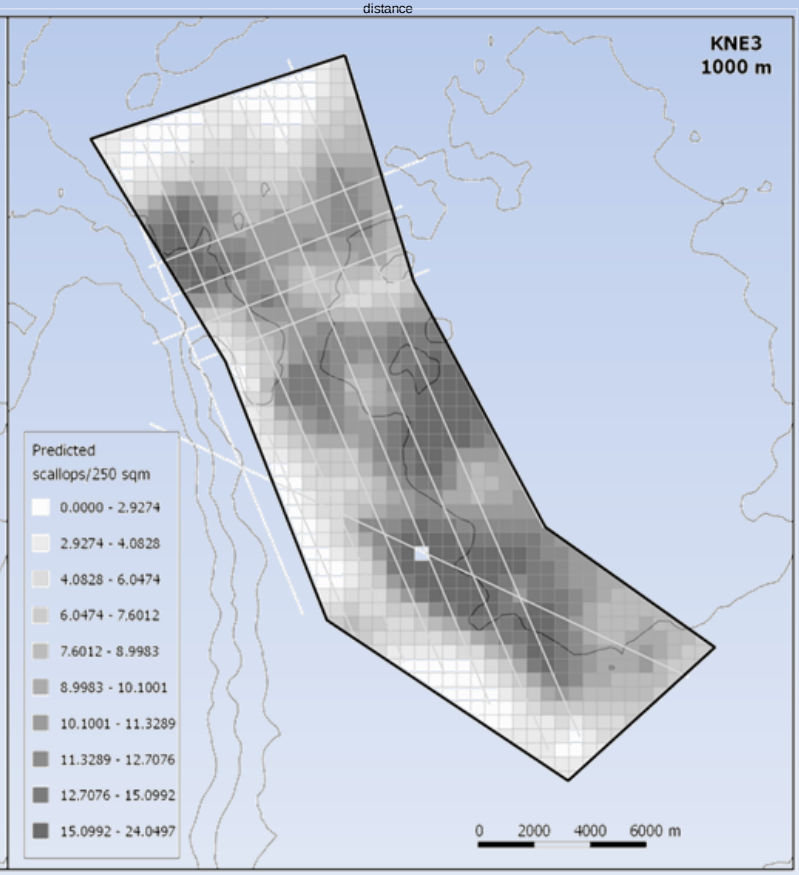

Alaska
Scallop
Fishery
Bering Sea
Gulf of Alaska
Image IBCAO
Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
261 mi
Google earth
Tour Guide
lat 57.281795° lon -166.185059° elev -199 ft eye alt 1000.69 mi


KNE3
224 km
29 hr
417,808 images
KNE6
55 km
7.7 hr
110,3848 images
weathervane scallop positions (jittered)
Strait
Barnabas Rock
0
30
km

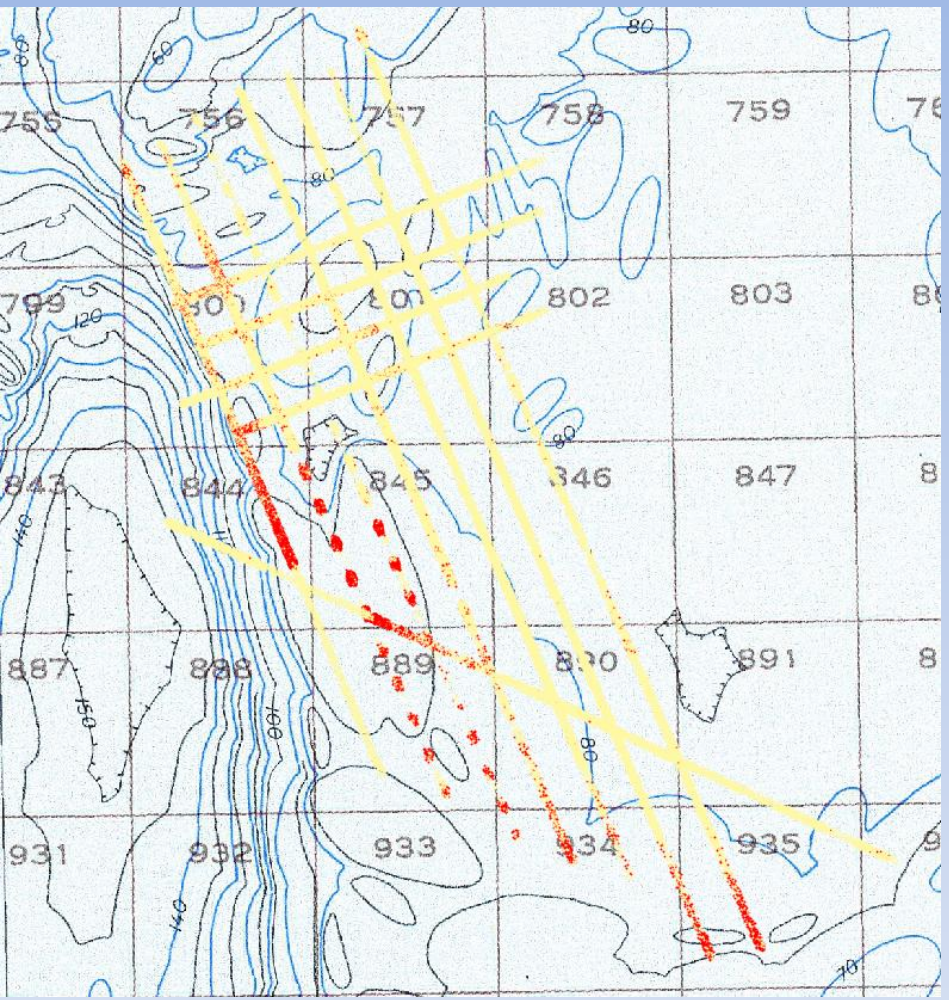

KNE3 Semivariogram 250m bins
semivariance
distance
20
40
60
80
100
2000
4000
6000


KNE3 Semivariogram 1000 m bins
semivariance
distance
10
20
30
40
50
2000
4000
6000

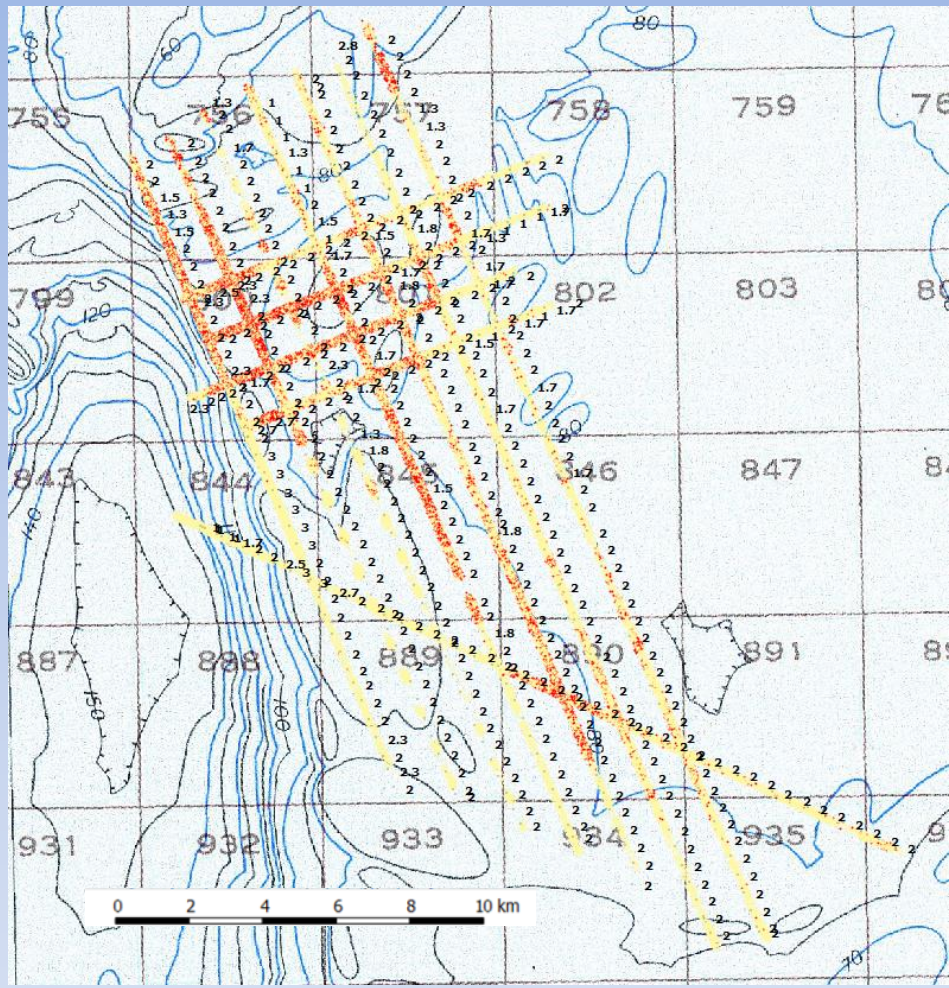

KNE3
250 m
Predicted
scallops/250 sqm
0.0000 - 3.5797
3.5797 - 5.1607
5.1607 - 6.3144
6.3144 - 7.5190
7.5190 - 8.5484
8.5484 - 9.1908
9.1908 - 10.2563
10.2563 - 12.2668
12.2668 - 15.9420
15.9420 - 34.7389
120 m
80 m
80 m


KNE3
1000 m
Predicted
scallops/250 sqm
0.0000 - 2.9274
2.9274 - 4.0828
4.0828 - 6.0474
6.0474 - 7.6012
7.6012 - 8.9983
8.9983 - 10.1001
10.1001 - 11.3289
11.3289 - 12.7076
12.7076 - 15.0992
15.0992 - 24.0497
0
2000
4000
6000 m

Data Visualizion

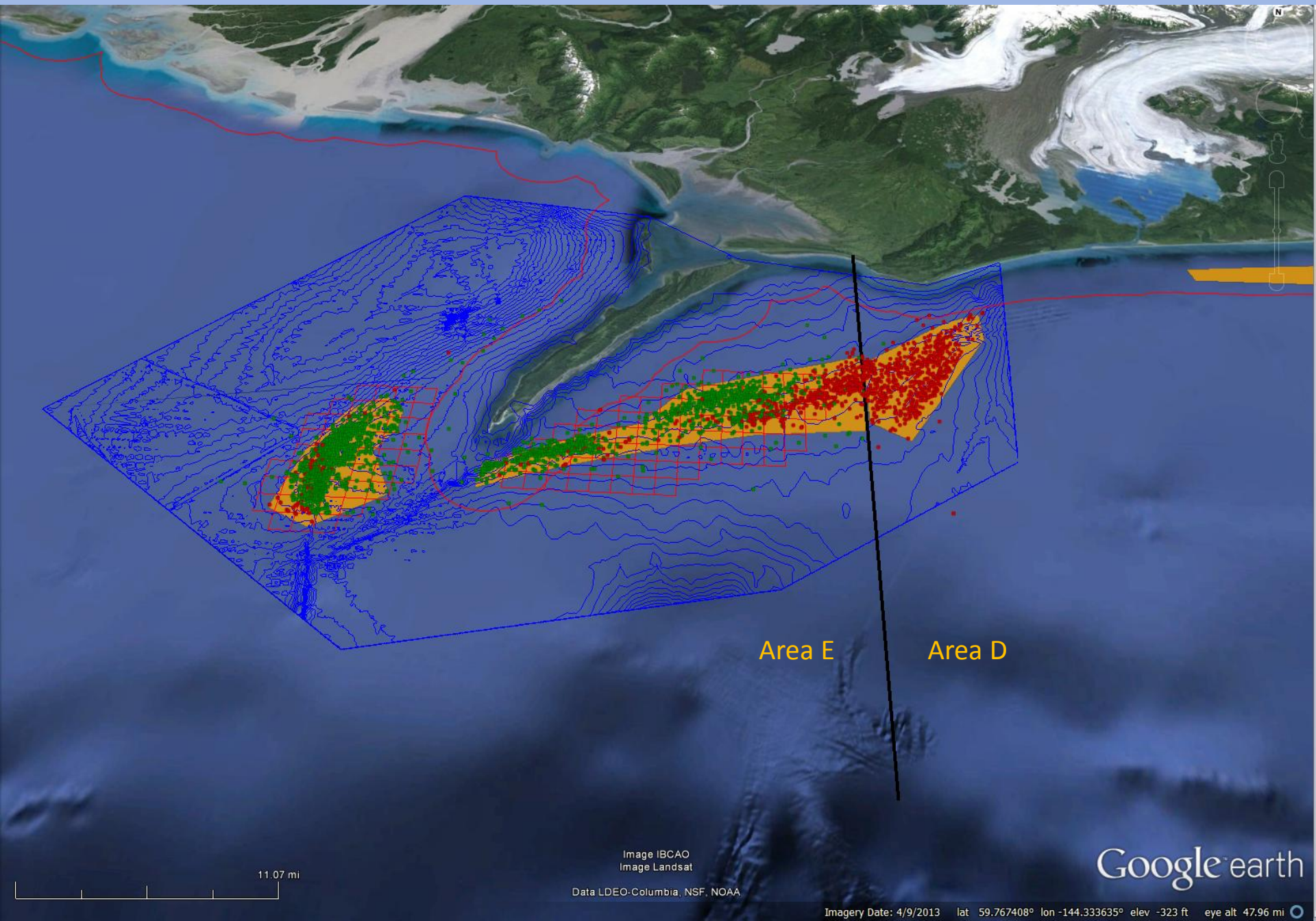


Chlamys sp. scallop positions (jittered)

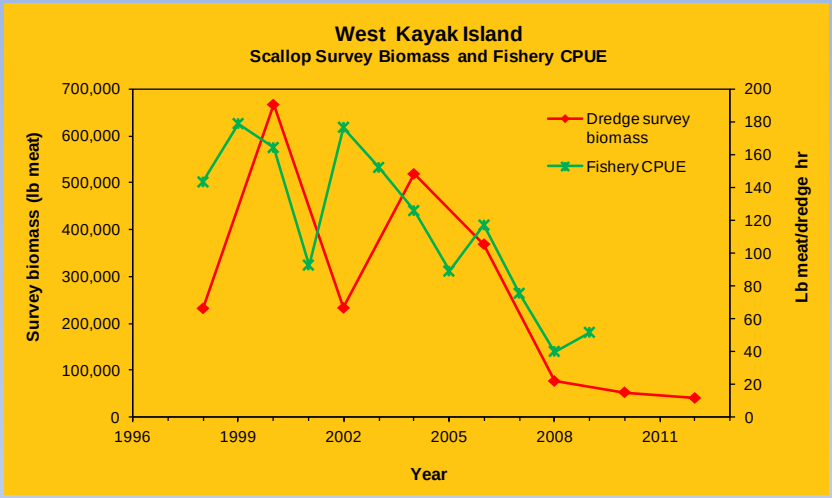


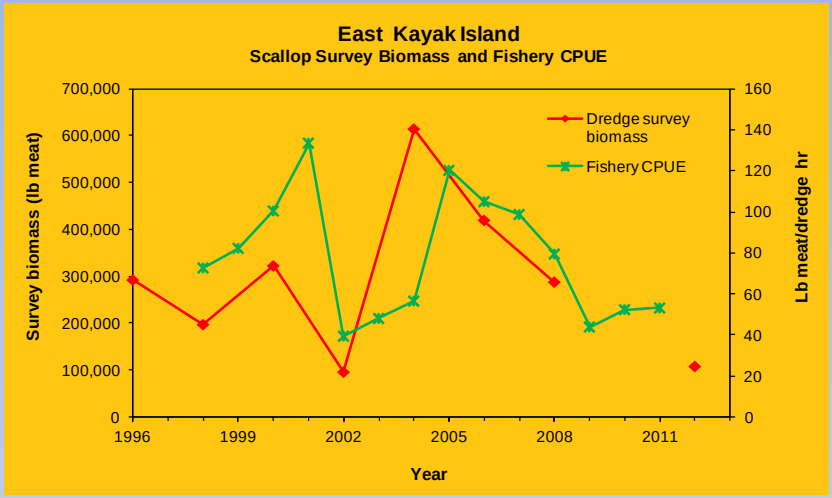
Metridium sp. locations and habitat scores

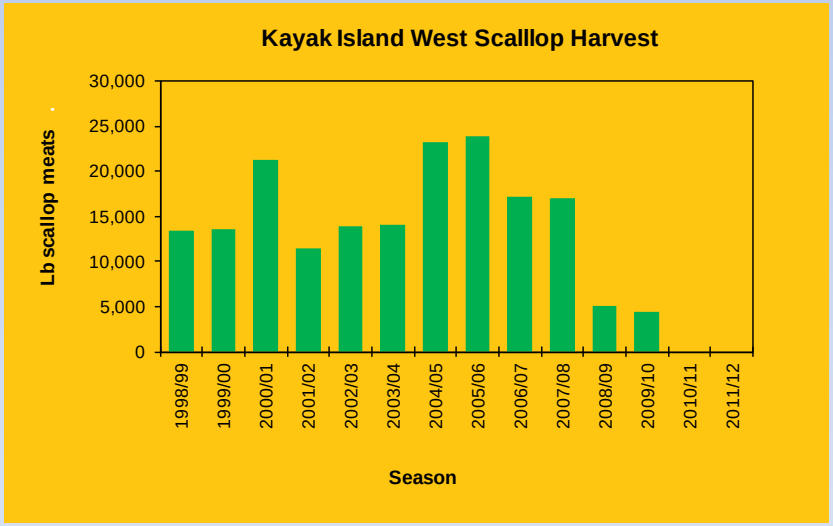
Kayak Island Scallop Fishery

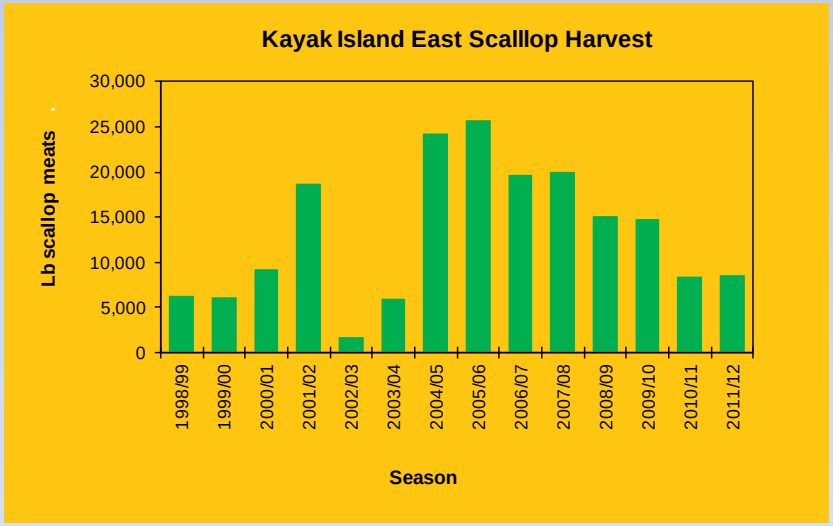


Comparison of Kayak Island scallop observer program CPUE with dredge survey biomass estimates





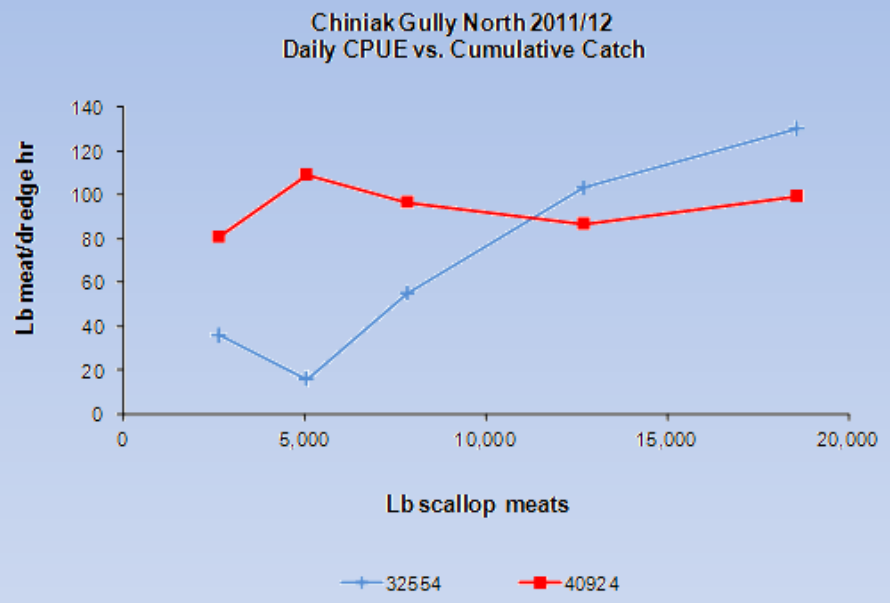


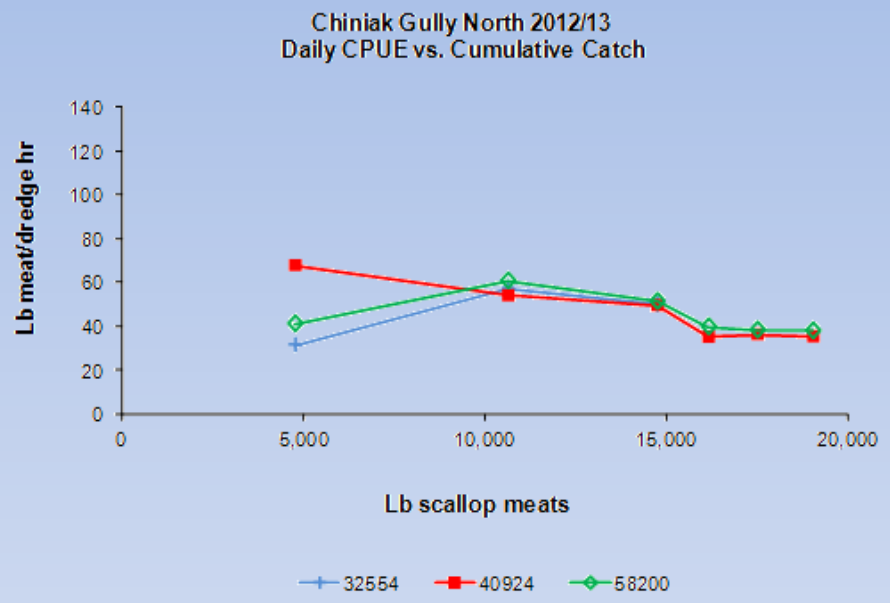


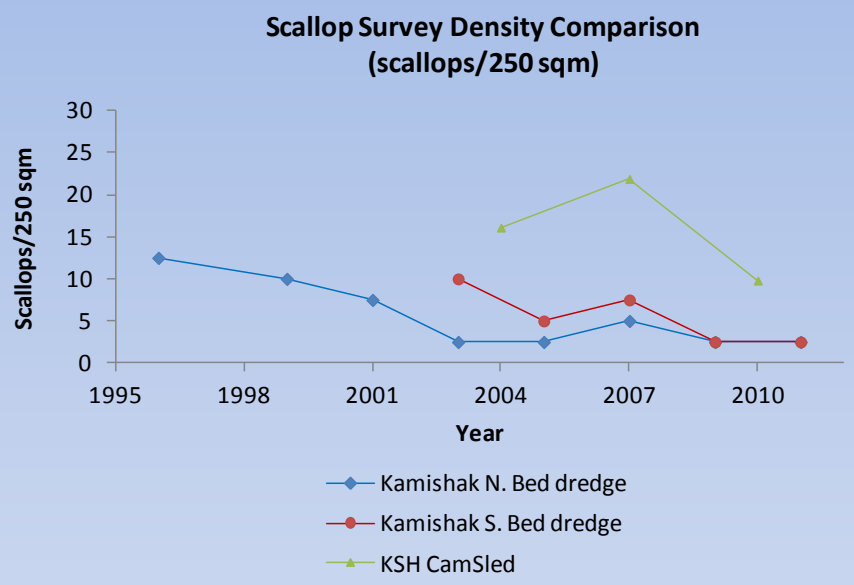
2000 – 2008 Harvest 147,054 lb
2000 – 2008 Δbiomass 589,676 lb

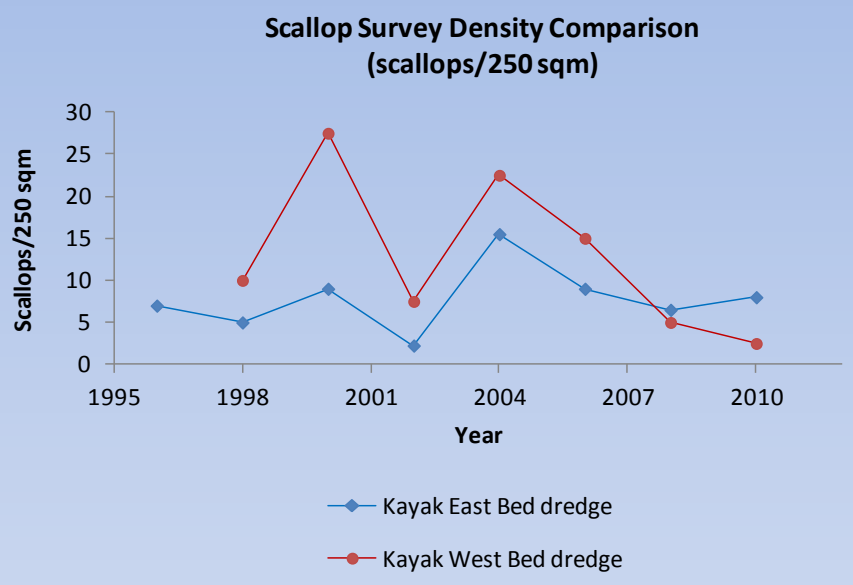
2004 – 2012 Harvest 136,054 lb
2004 – 2012 Δbiomass –506,529 lb

Scallop fishery CPUE comparison






Scallop Survey Density Comparison
(scallops/250 sqm)
Scallops/250 sqm
30
25
20
15
10
5
0
1995
1998
2001
2004
2007
2010
Year
Kamishak N. Bed dredge
Kamishak S. Bed dredge
KSH CamSled


Scallop Survey Density Comparison
(scallops/250 sqm)
Scallops/250 sqm
30
25
20
15
10
5
0
1995
1998
2001
2004
2007
2010
Year
Kayak East Bed dredge
Kayak West Bed dredge

Off Cape St. Elias
6/28/08
59.708° N 144.732° W
79 m 6.1 °C

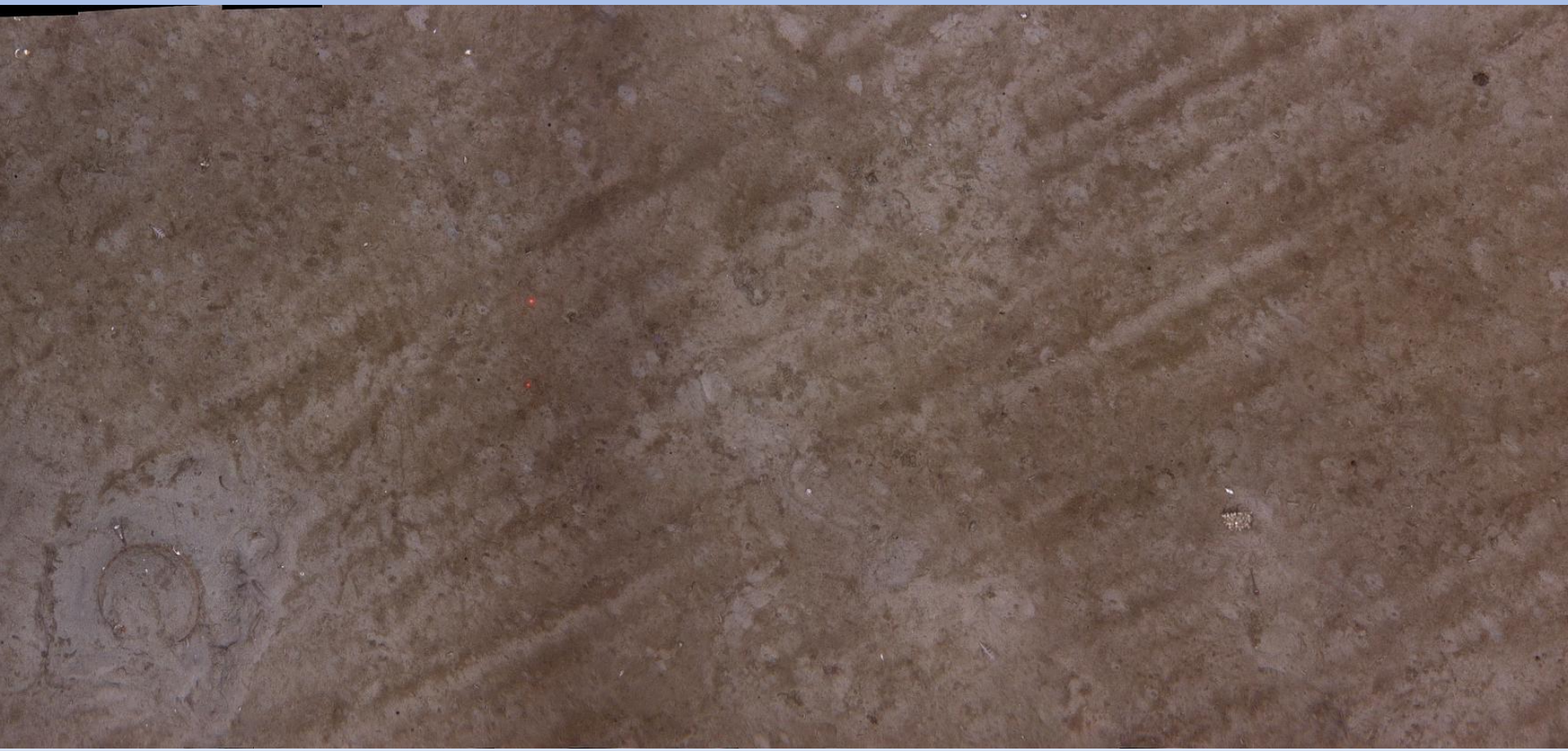
Species interaction:

sunflower sea stars
Pycnopodia helianthoides
&
weathervane scallops
Patinopecten caurinus

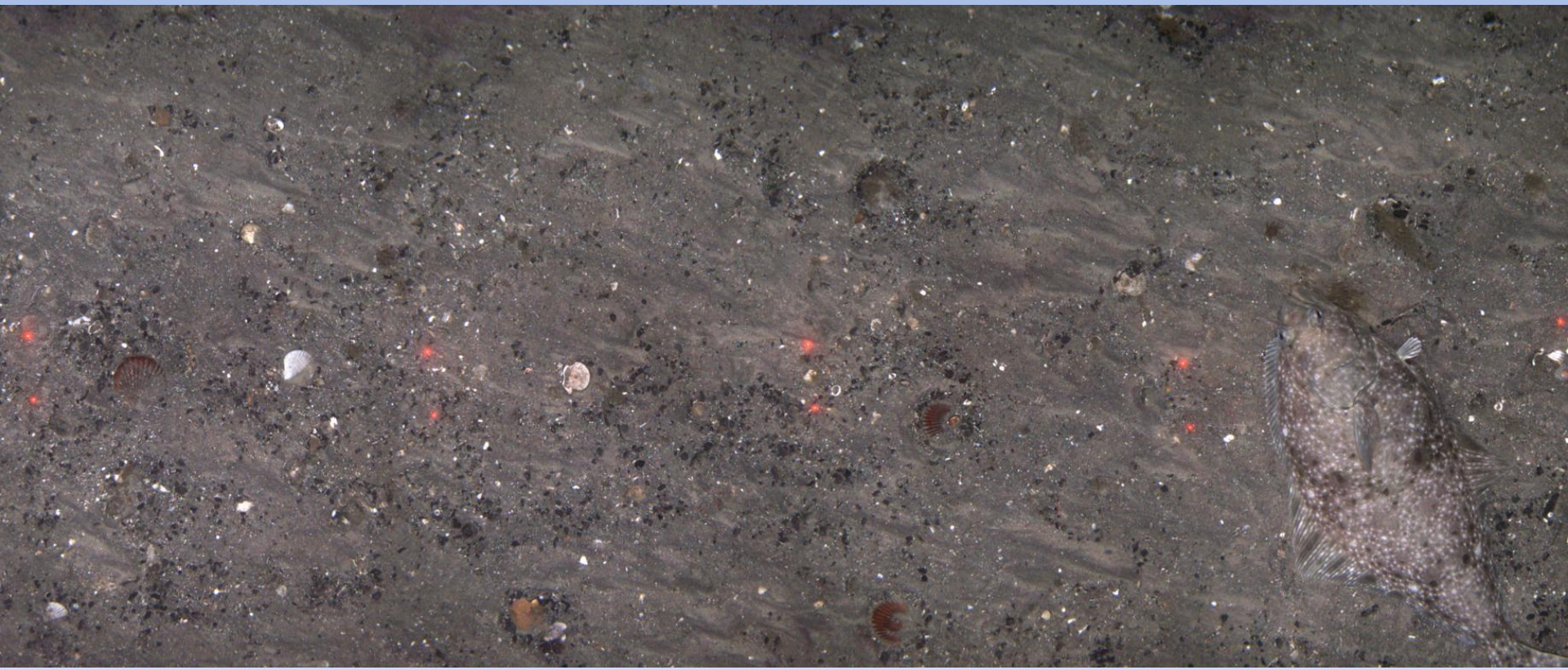
Alaska CamSled
High
Resolution
Benthic Imaging

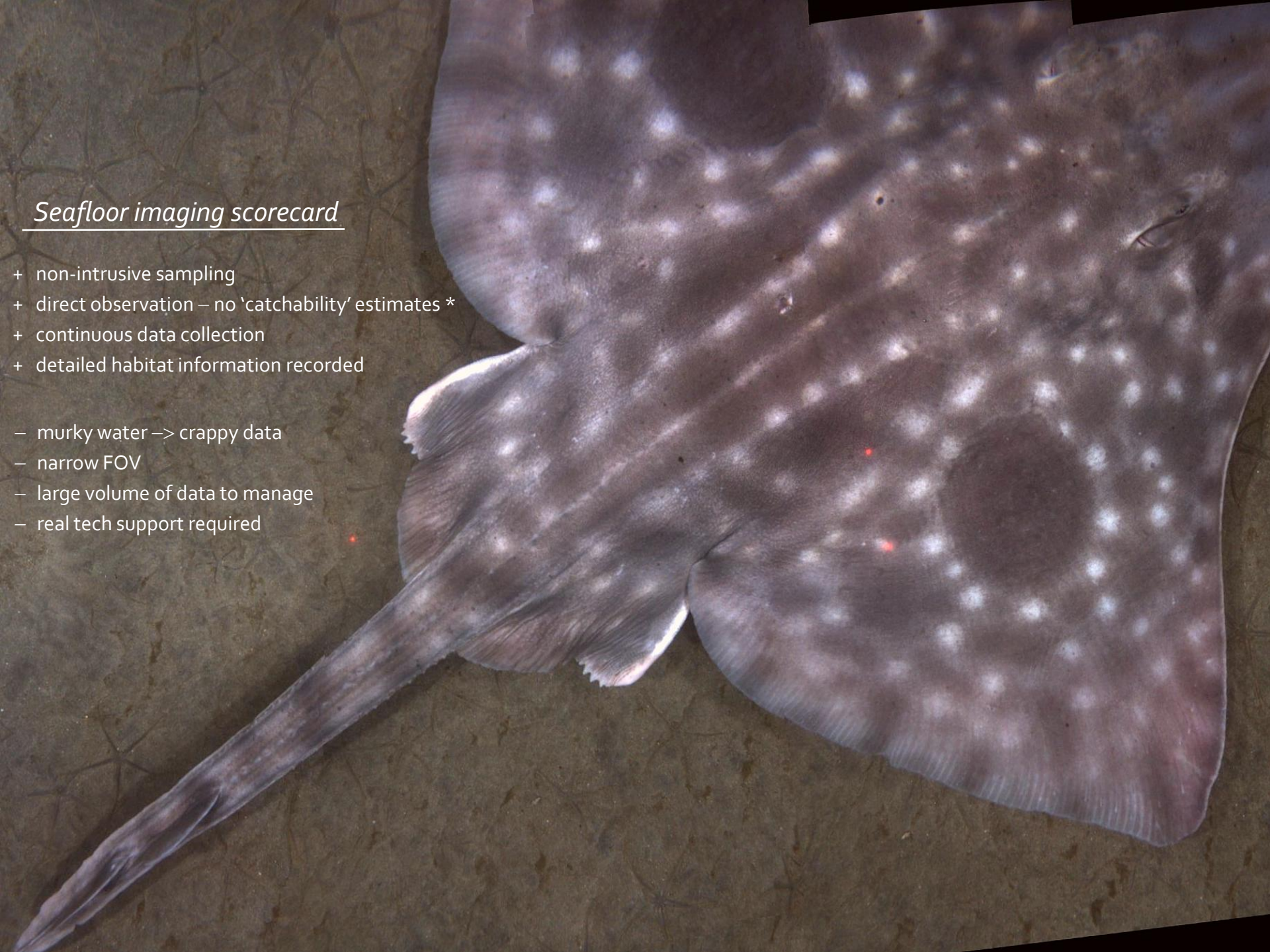
Species interaction:
Giant Pacific octopus
Enteroctopus dofleini
&
weathervane scallops
Patinopecten caurinus

Effects of fishing/dredge efficiency



Effects of fishing/EFH/ACLs



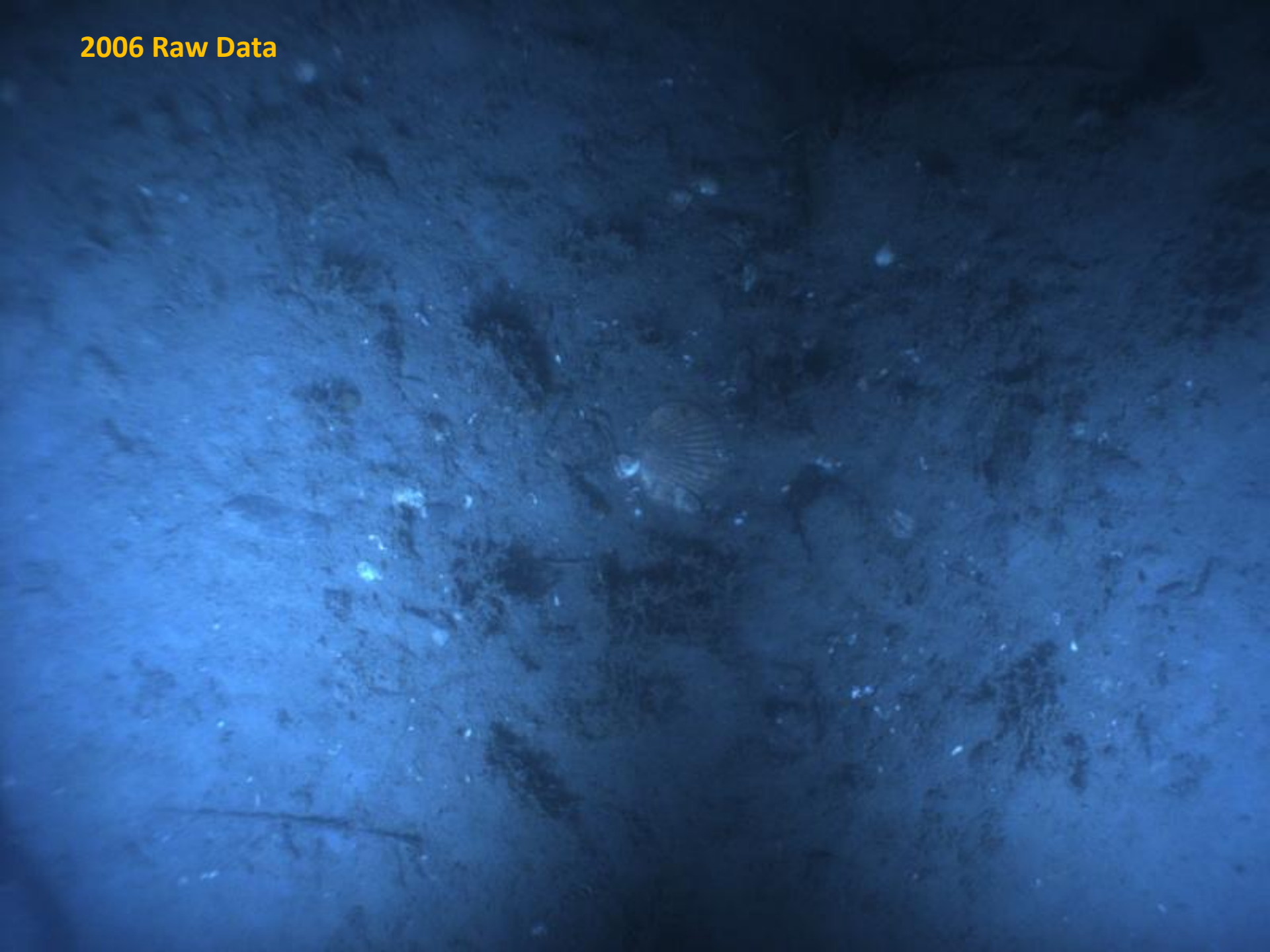


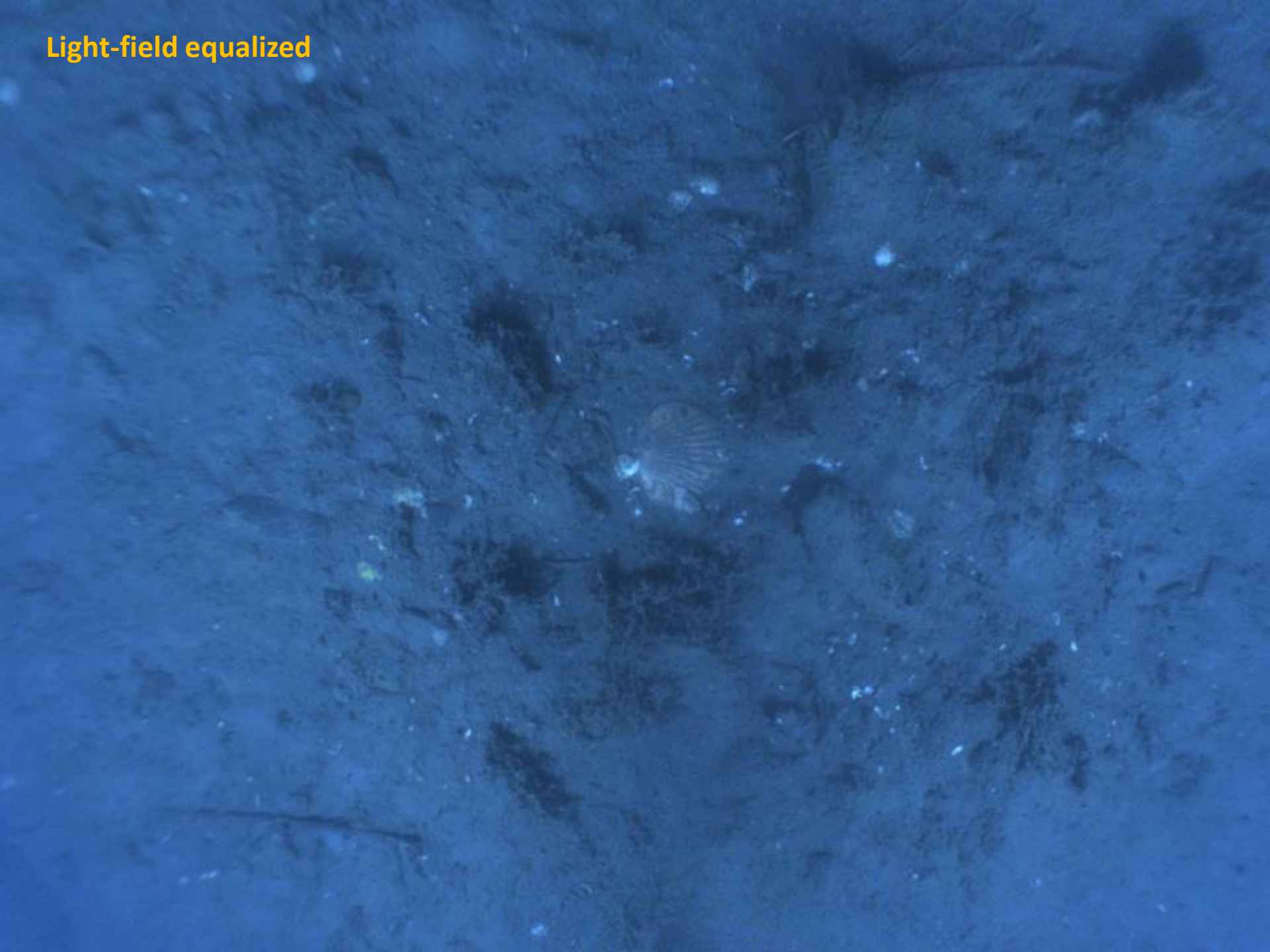
Seafloor imaging scorecard

+ non-intrusive sampling
+ direct observation – no 'catchability' estimates *
+ continuous data collection
+ detailed habitat information recorded

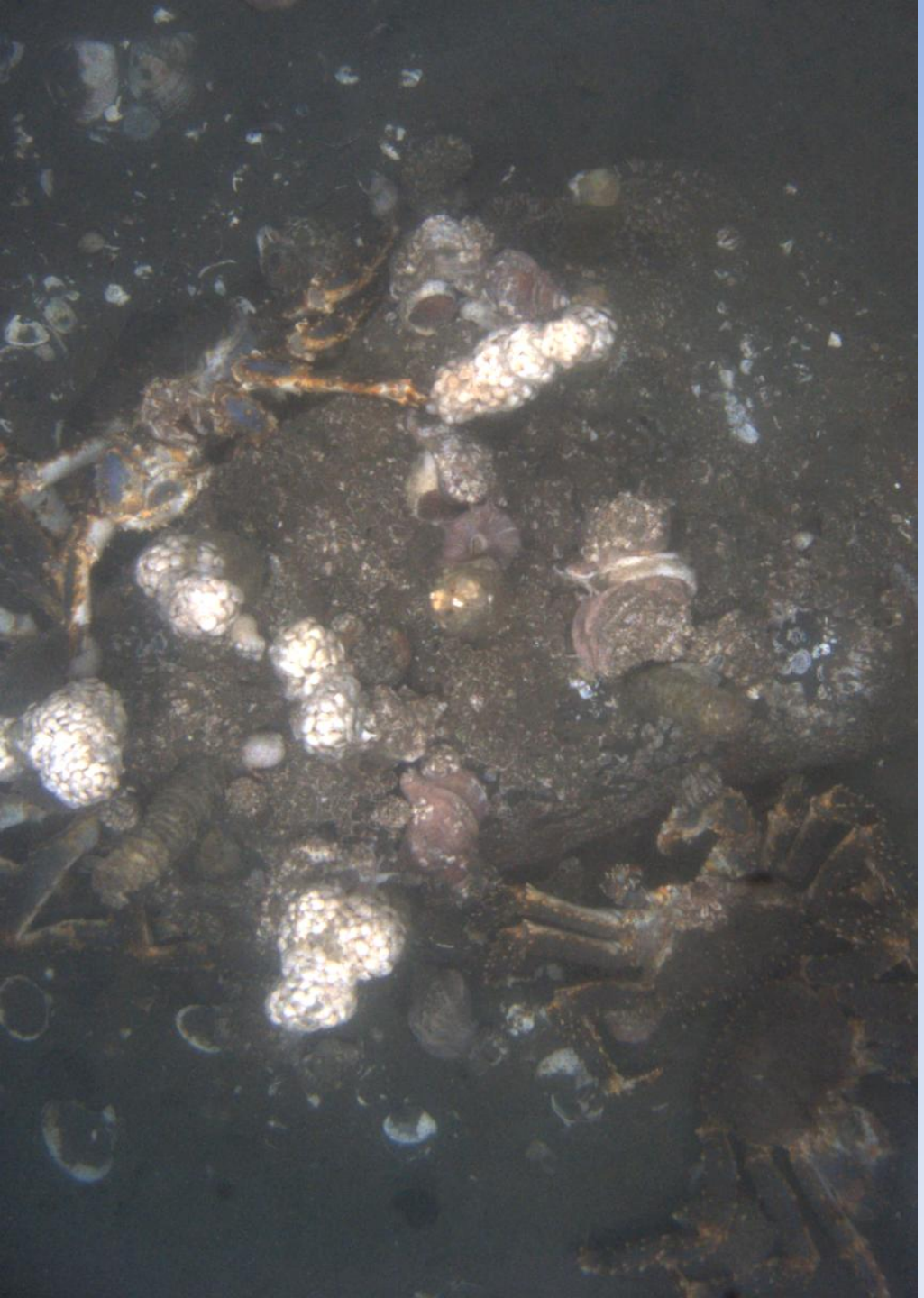
– murky water –> crappy data
– narrow FOV
– large volume of data to manage
– real tech support required

2006 Raw Data




Light-field equalized

Light-field equalized
color corrected
contrast enhanced



Thanks to:

HabCam/Scott Gallager
Mark Hottmann
David Barnard
William Gaeumann
Carrie Worton
Mike Byerly
Lisa McCormick

Paul Converse
Marsha Spafard
Phillip Tschersich
Doug Pengilly
Daniel Doolittle
Mark Blakeslee

RV *Pandalus*
RV *Resolution*
CP *Arctic Hunter*
CP *Provider*
Alaska Scallop Association

Bay Welding Services
Kodiak Metals
Desperate Marine
Fred Nass Machine Shop
Alaska Hydraulics