

Fisheries Management Law & Economics

Emerging Management Techniques

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Outline

Recap – Ecosystem Based Management

Emerging Management Techniques

- Genetics
- Fisheries Observers
- Electronic Observation (Photo/Video)
- Acoustics / Hydroacoustics (Listening/Sonar)
- AUV's & Drones

Student Learning Objectives

- Recall the framework behind ecosystem based management
- Describe how genetics can be used to tag, track, and manage fish populations.
- Illustrate the role of fisheries observers, and the pros and cons of the observers program.
- Recall the different types of electronic observation, and the benefits and fallbacks of the technique.
- Describe how acoustics, specifically hydroacoustics can be used to track, estimate, and manage fish populations.
- Recall the uses of AUV's and drones in fisheries management and how they can reduce the need for man power.

Ecosystem Based Management (EBM)



Recap

- Ecosystem Based Management
 - Reduce bycatch
 - Marine reserves
 - Monitoring of population characteristics
 - Catch share programs
 - Ecologically sustainable yield

Using Advanced Technologies to Assess Fish Stocks



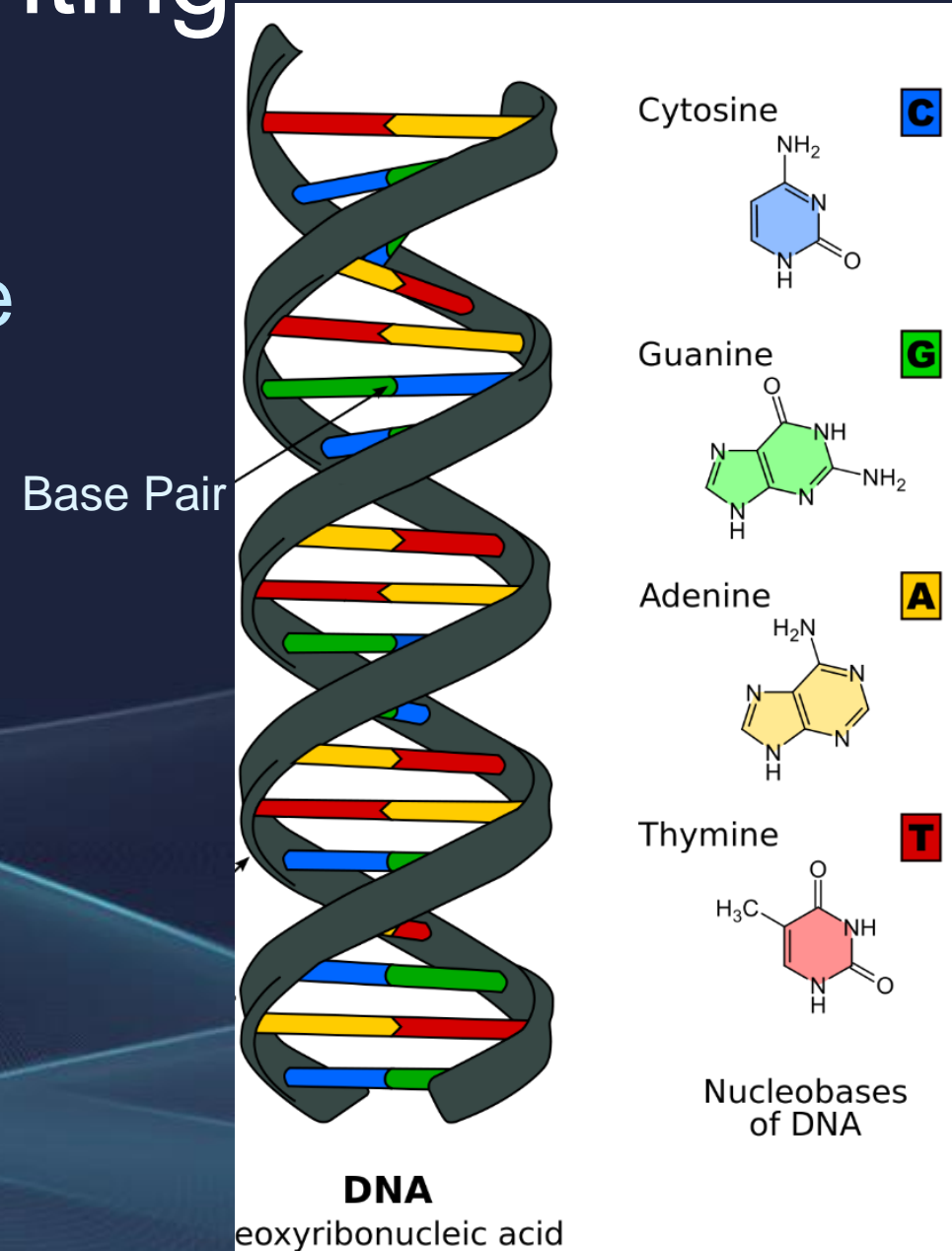
Genetics and Fisheries

- <http://vimeo.com/110201354>
- Salmon industry depends on wild & aquaculture production
 - Hatchery development if not done with care could hurt wild populations
- ADF&G Protect Wild Salmon Stocks
 - Development of Genetic Policy in 70's
 - Genetically manage brood stock
- Recently this has transitioned into Management



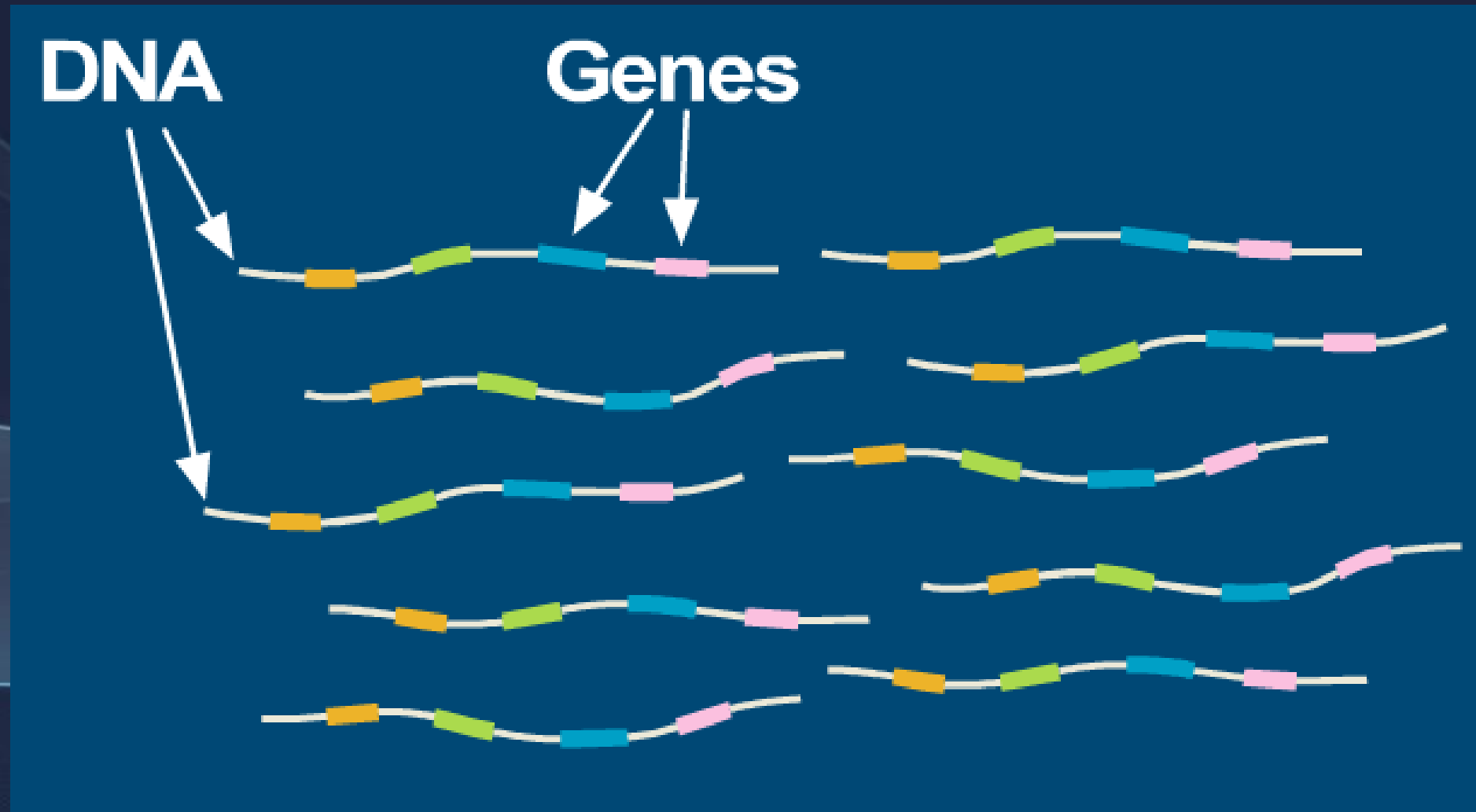
Genetic Fin Printing

- DNA - Deoxyribonucleic acid
- DNA is a molecule that encodes the genetic instructions used in the development and functioning of all known living organisms and many viruses.
 - Made up of 4 chemical Bases CGAT
 - Form pairs or Base Pairs
 - Double helix



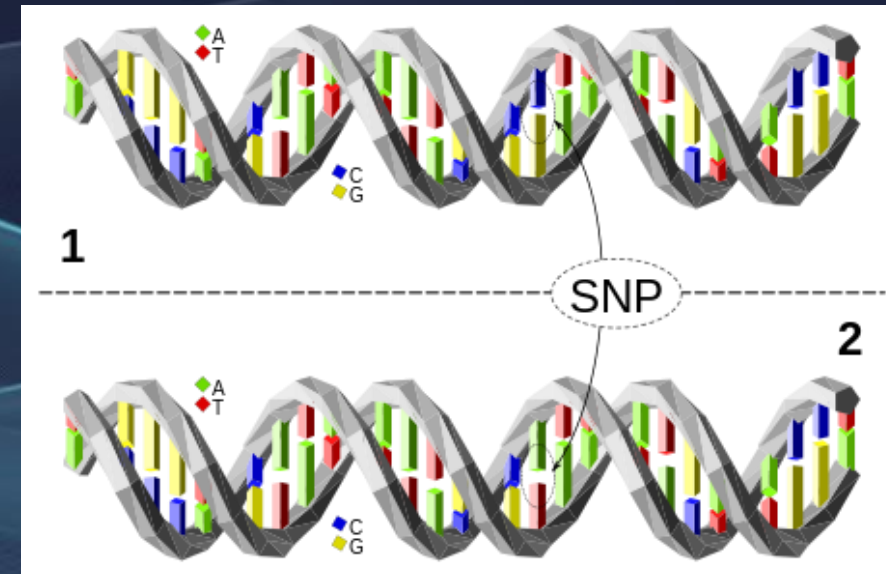
Genetic Fin Printing

- Genes are regions of DNA that code for traits



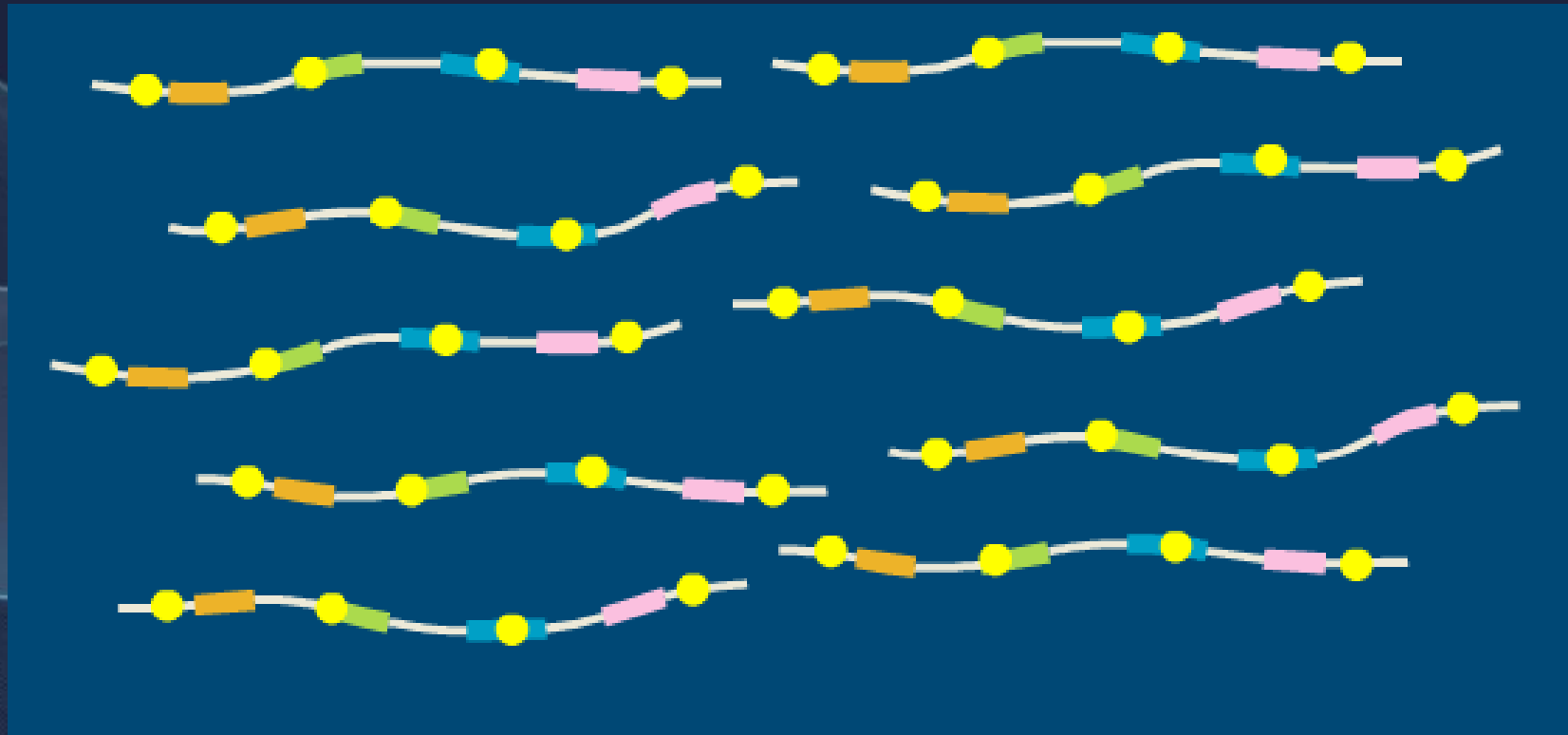
Genetic Fin Printing

- **Microsatellites** also known as simple sequence repeats (SSRs) or short tandem repeats (STRs), are repeating sequences of 2-5 base pairs of DNA
 - Have higher mutation rate than other areas
- **Single-nucleotide polymorphisms (SNPs)**
 - 1 in 300
 - 10 million per person

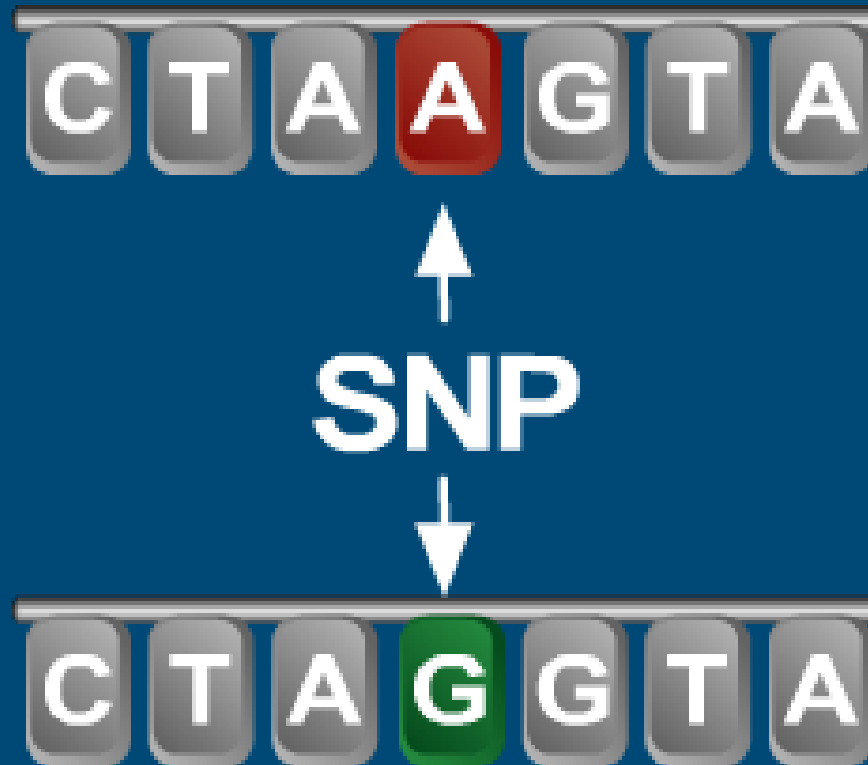


Genetic Fin Printing

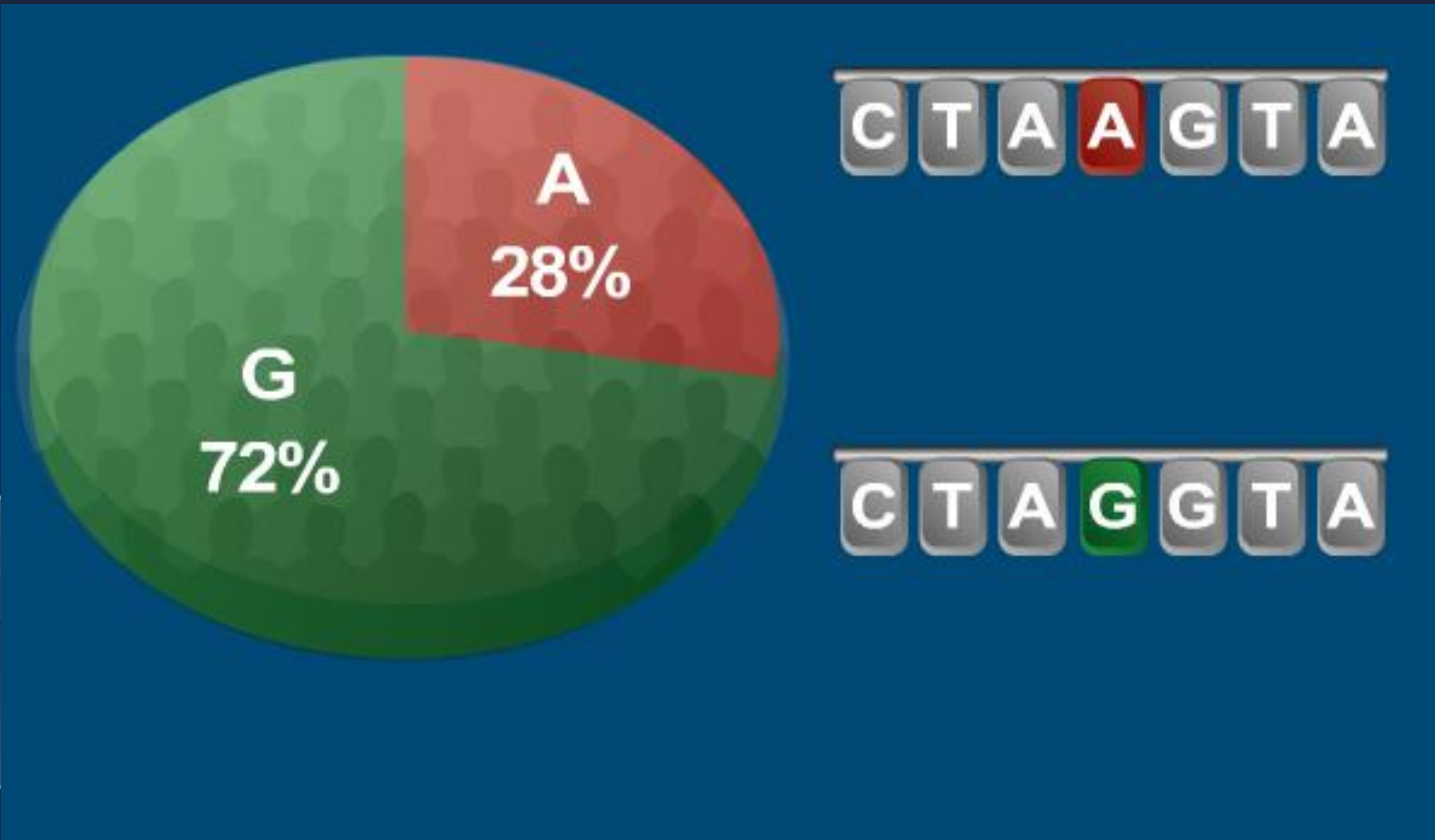
- Single-nucleotide polymorphisms (SNPs)
 - 1 in 300 nucleotide
 - 10 million per person



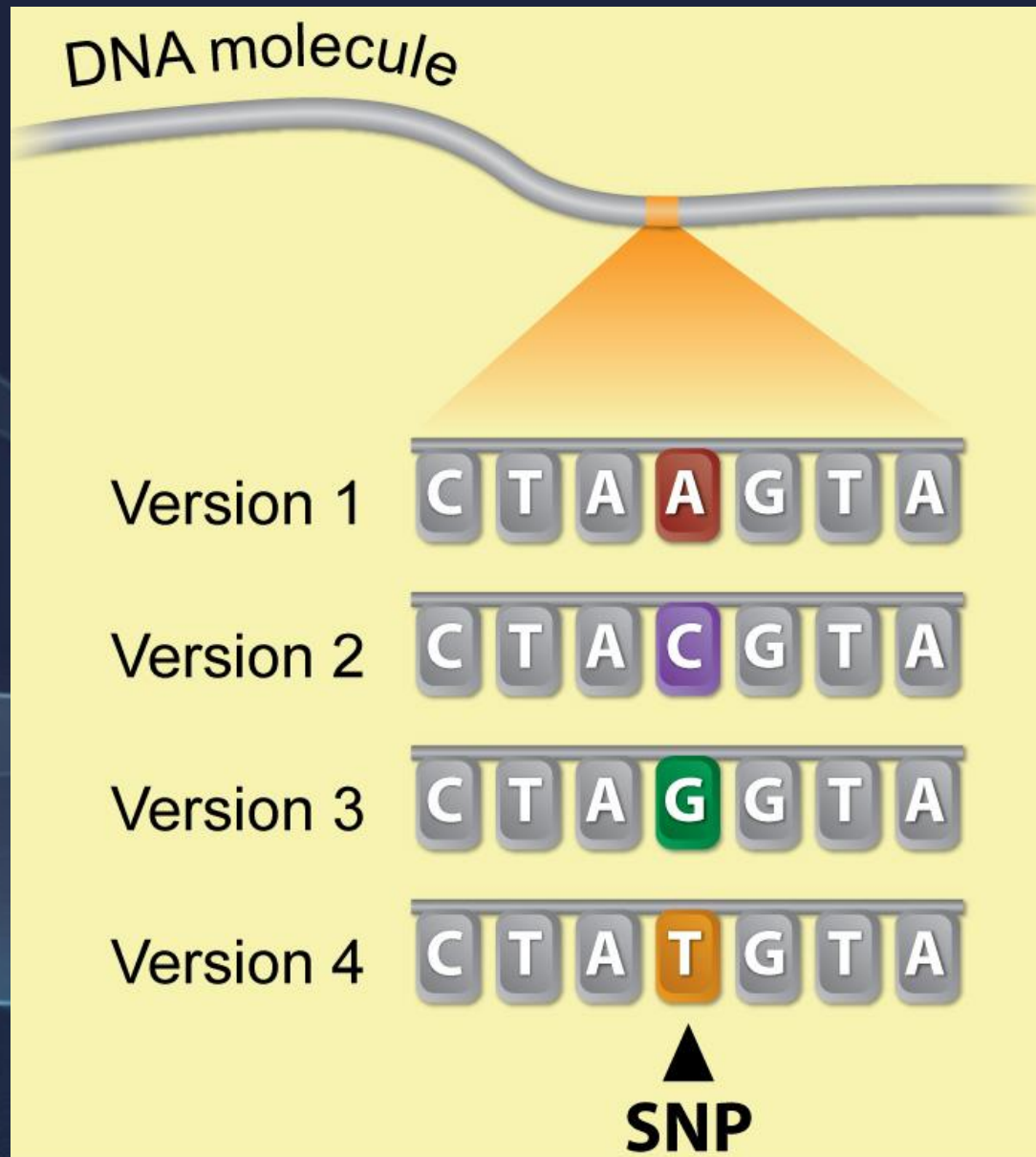
SNPs



SNPs



SNPs

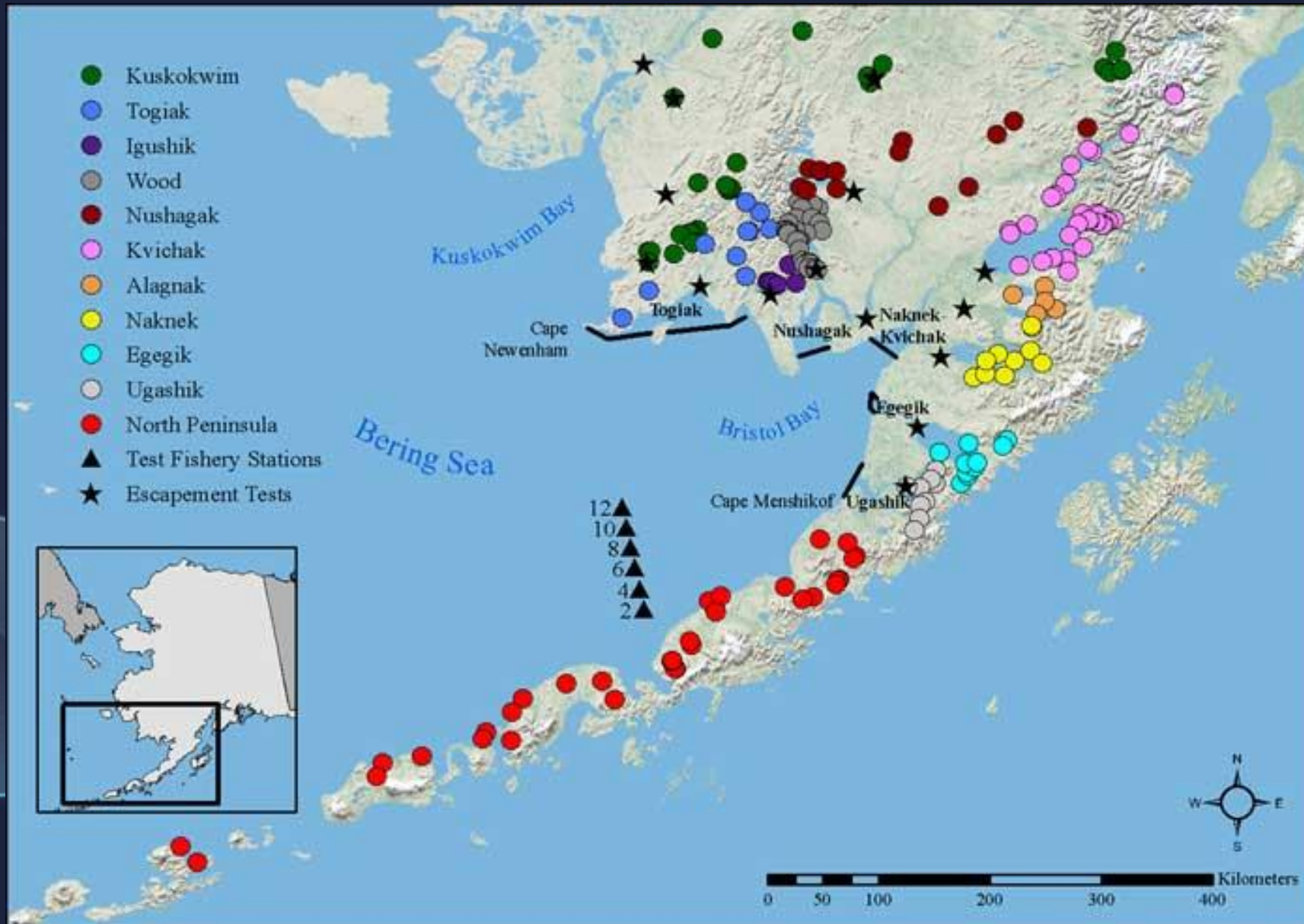


Fin Printing in Fisheries

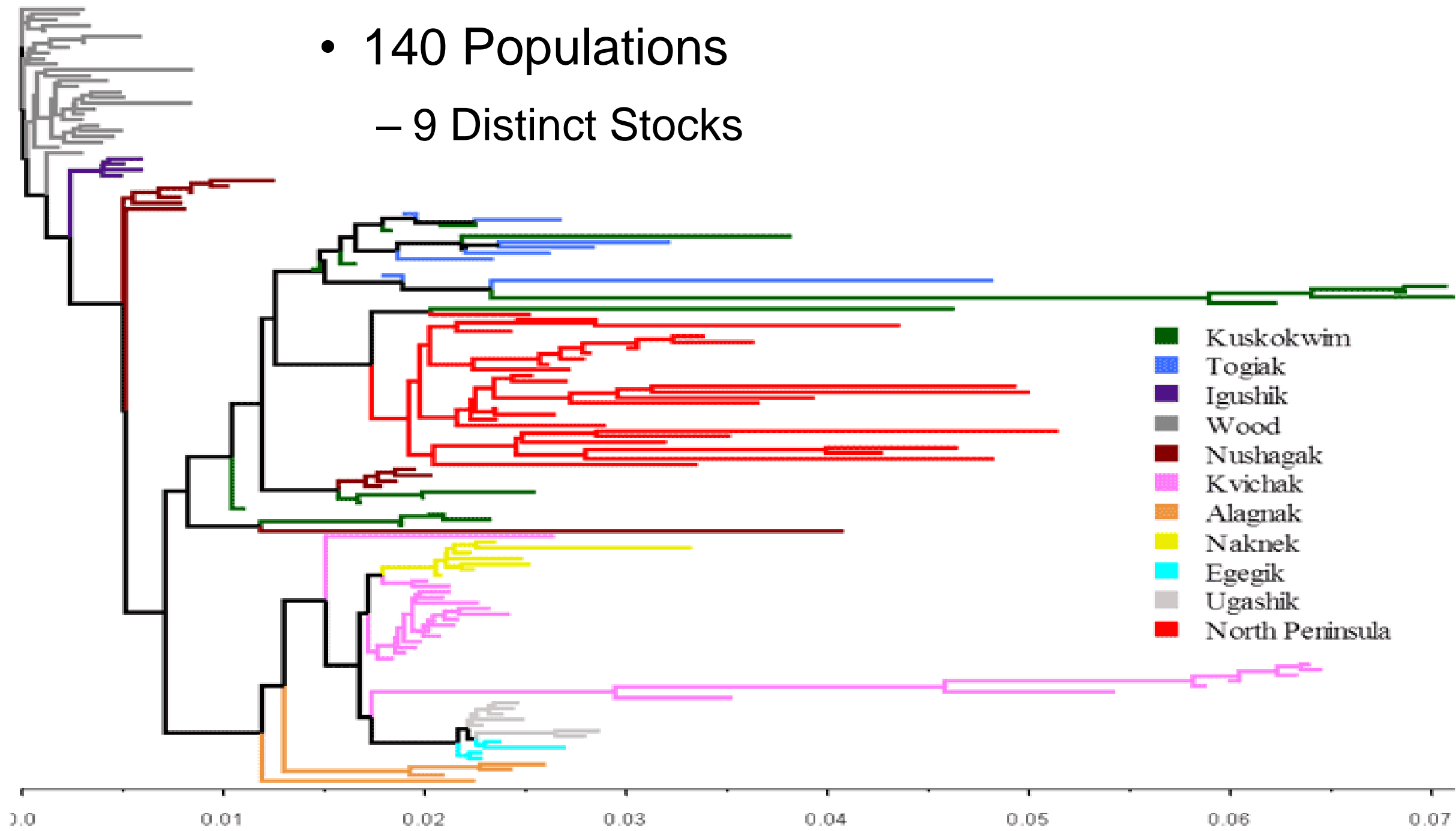
- Allows for specific stock identification



Fin Printing in Fisheries



- 140 Populations
- 9 Distinct Stocks



What managers do with this information?

- Allows for better targeting of fishery
- Allows for more predictable forecasts

- What else?
- Bycatch in Trawl fishery
- What about marine populations?
 - Improve genetic stock identification of Chinook salmon from western Alaska
 - Even Sex identification

Self Check

- SNP's stands for
 - Simple sequence repeats
 - Short tandem repeats
 - Single-nucleotide polymorphisms
 - Deoxyribonucleic acid
- Which can NOT be determined from Genetic analysis of fish tissues
 - Sex
 - Species
 - Stock of origin
 - All can be determined through Genetic analysis



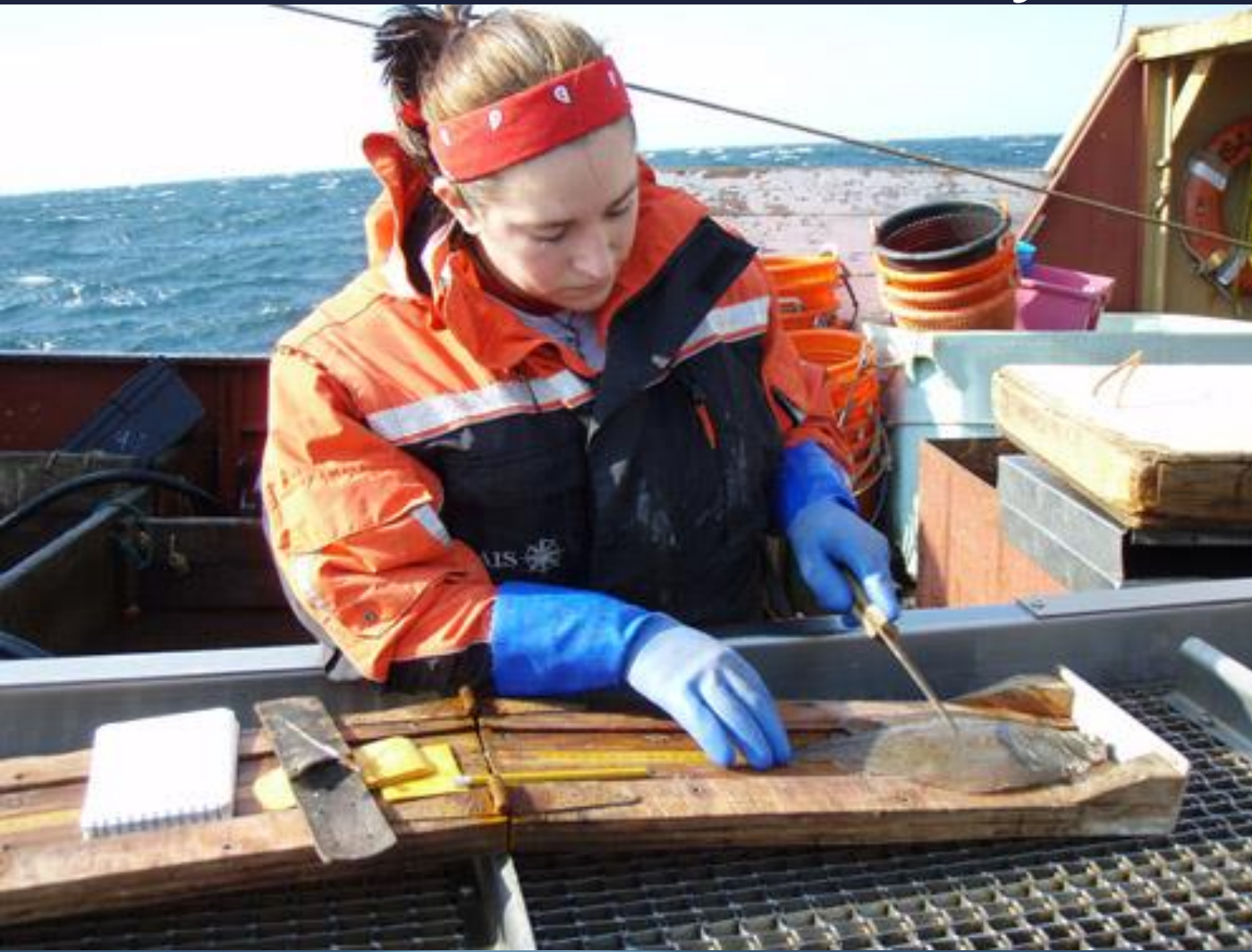
FISHERIES



OBSERVER



Fishery Observers



Observer Program

- NOAA Fisheries (Since 1972)
- Record Catch and Bycatch data
 - Commercial and Processing vessels
- 47 Fisheries Monitored
- 77,000 Observer days at sea
- In 2013 Expanded to fill data gaps

NMFS Observer Programs

- Authorization:
 - Magnuson-Stevens Act
 - Marine Mammal Protection Act
 - Endangered Species Act*
- Funding Sources
 - Federal, Industry
- Statistics (2007):
 - 42 fisheries observed
 - Annual deployment of 700+ observers
 - Over 64,000 sea days
 - 1,817 days of electronic (video) monitoring



Who are Fisheries Observers?

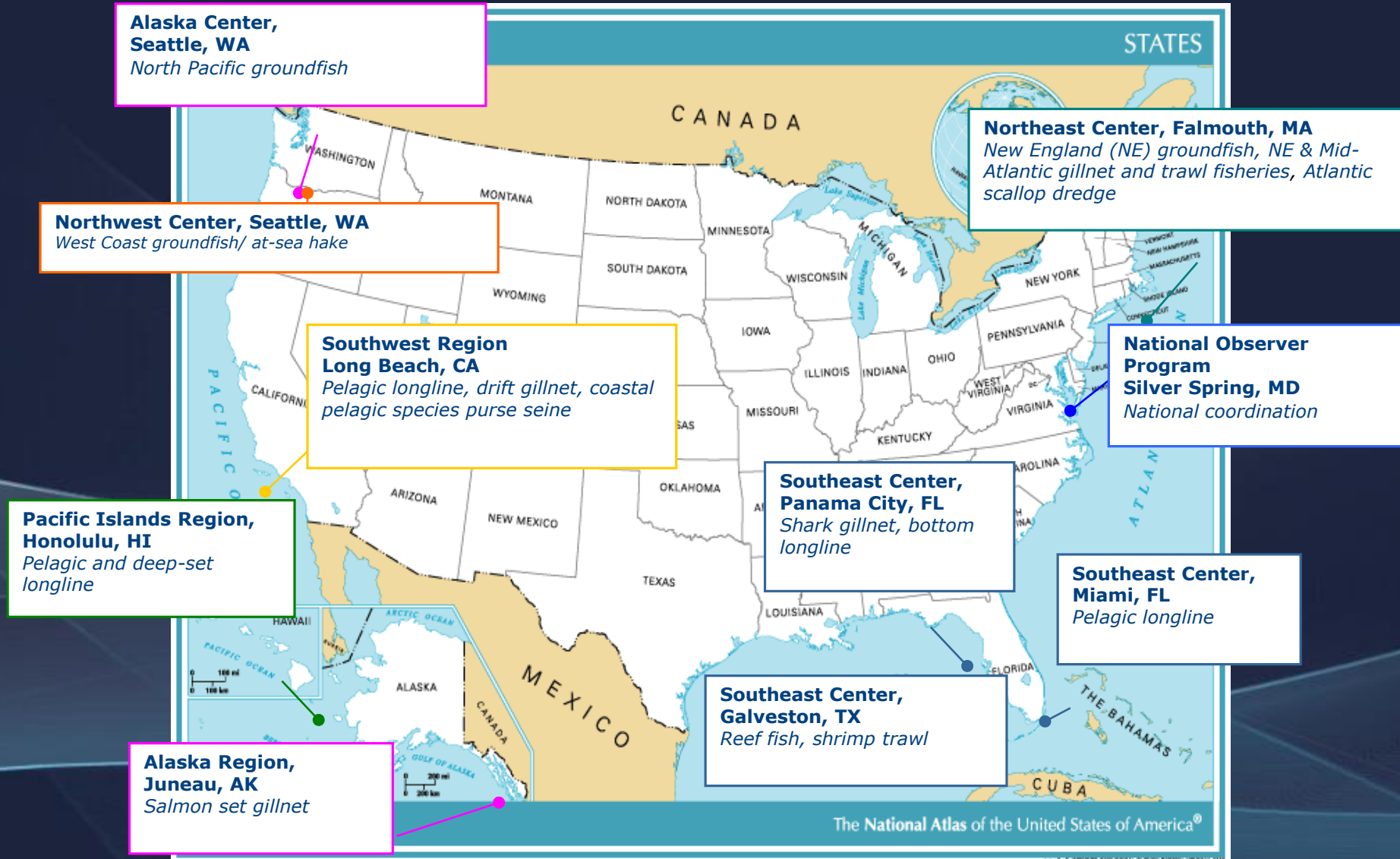
- Contractors
- Degree in Biology
- Background in wildlife, fisheries, fishing technology, environmental sciences, wilderness survival
- Experience at sea desired
- No conflicts of interest and
- Good health



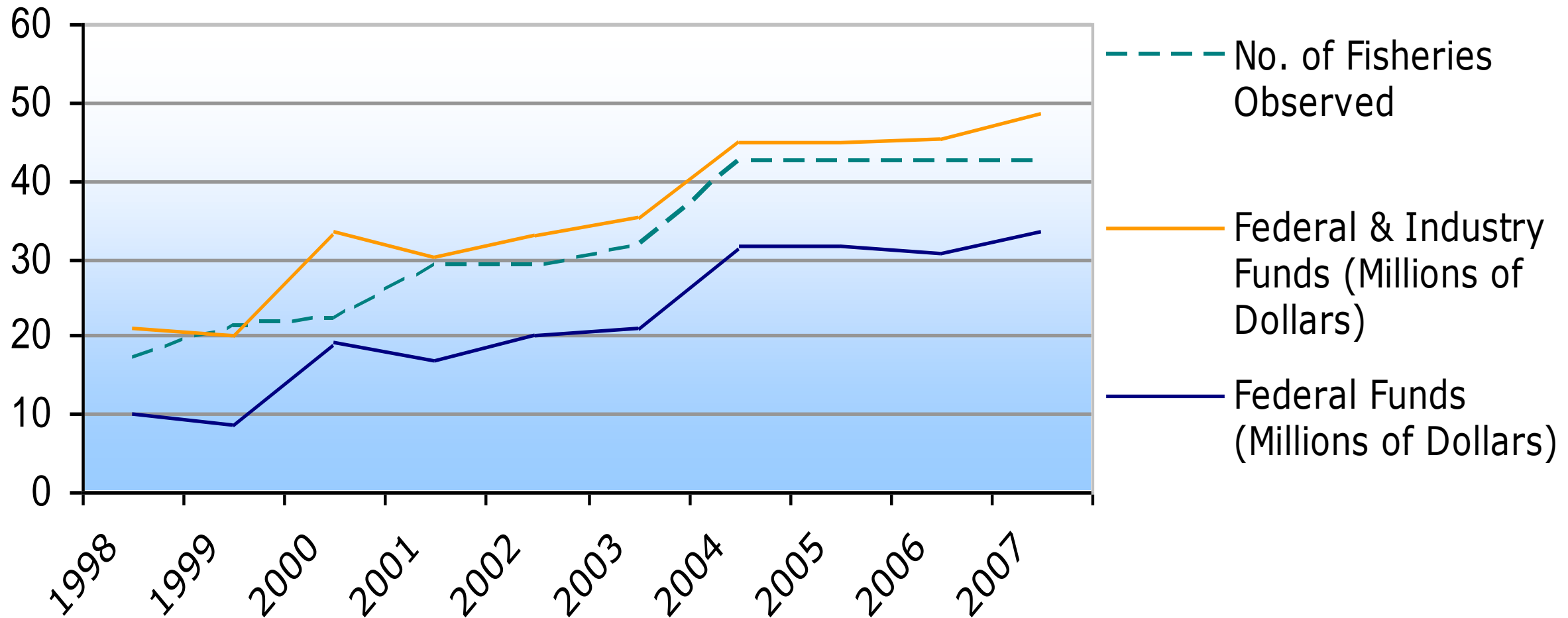
Observer Role & Responsibilities

- Observers collect data; are not enforcement agents
- While aboard the vessel, observers:
 - Estimate weight of retained and discarded catch.
 - Determine species composition of discarded catch.
 - Identify reasons for discard for each species.
 - Record weight, length, sex, dissections from tagged fish.
 - Take biological samples such as sex, lengths, otoliths, stomachs, coral tissue, etc. from discarded individuals.
 - Document sea turtle, marine mammal, bird interactions.

NMFS Observer Programs - Locations



Observer Programs Funding History



Cost Comparison

- Recently NMFS observer programs completed a comparison of the cost for an observed day at sea.
 - Developed for the North Pacific Council to aid in restructuring analysis for the Groundfish Observer Program (industry funded).
- Examined cost per sea day:
 - Across regions, and
 - Across observer job classifications (e.g. Observer 1, 2)
- Determined what was comparable across programs.
 - Minimum pay: DOL wage determinations
 - Maximum number of hours worked per day, per week
 - Fringe benefits (e.g. FICA, Medicare, etc.)

Cost Comparison, cont.

- Examined programs under government contract
- Differences were identified in
 - Standard work day hours (range: 10-16 hrs)
 - Hours worked per week (range: 70-112 hrs)
 - Overtime hours (range: 30-72 hrs)
 - “Other contract costs” – for example
 - Travel, transportation, lodging
 - Overhead, administration
 - Recruitment costs
 - Vessel reimbursements
 - Insurance



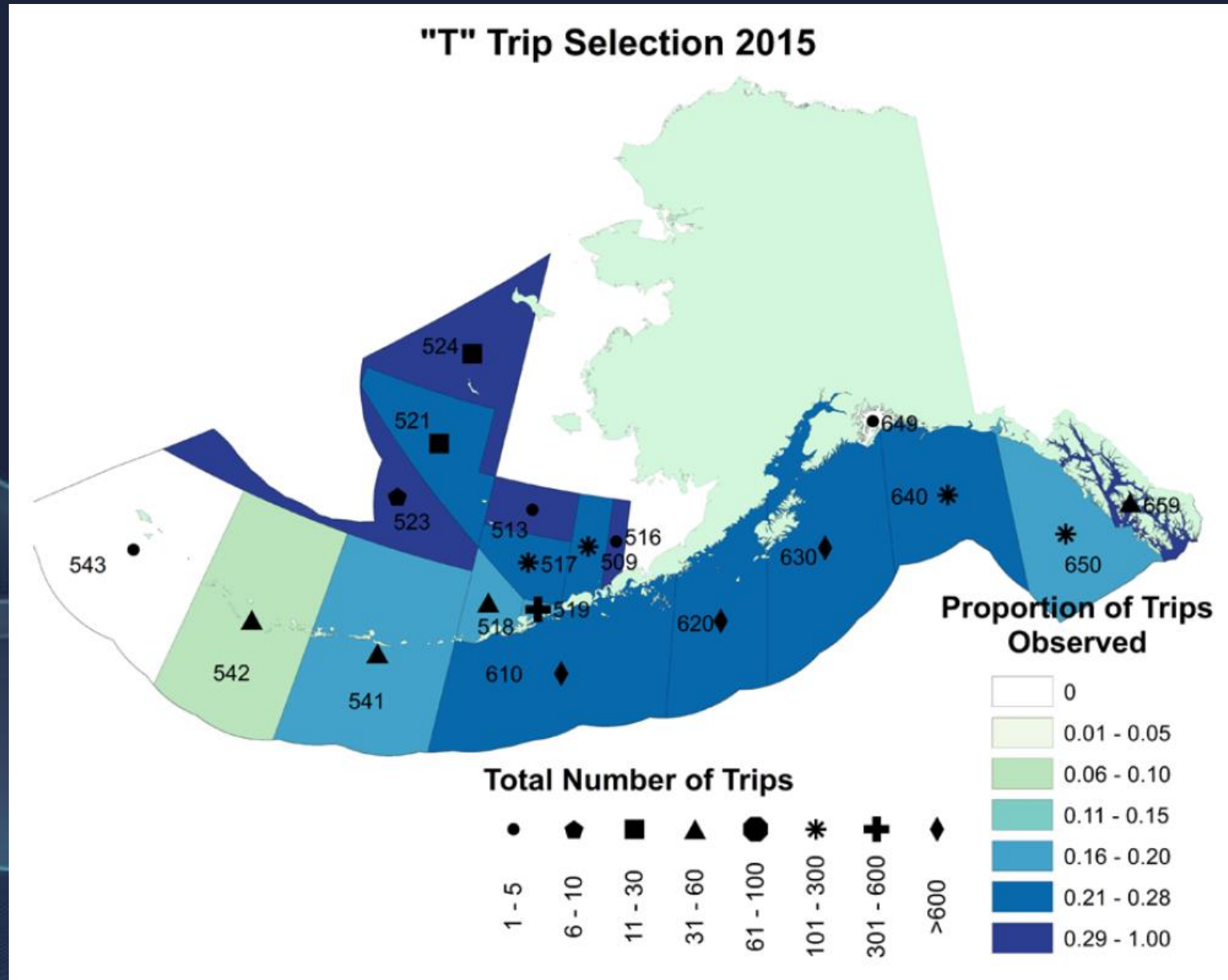
Cost Comparison cont.

	Northeast	Southeast	AMMOP	Northwest	Southwest	Pacific Islands
Total Wage per Hour *	\$16.83 - 20.23	\$16.83 - 20.23	\$17.05 - 20.35	NA	\$16.46	\$13.61 - 14.43
Maximum Hours Worked per Day	12	16	12	NA	10	10
Maximum Hours Worked per Week	84	112	84	NA	70	70
Total Cost Per Day – Observer Salary/Benefits Only**	\$288.04 – 352.40	\$394.84 – 484.70	\$285.55 - \$347.01	\$363.75 - 436.25	\$223.80	\$215.79 - 228.24

\$1,071 / day 2015

Trips Observed 2015

- In Alaska 4,859 trips (39.1%) and 498 vessels (42.1%) were observed in 2015
- Budget of \$5 M for AK groundfish



Observers

- Observer Issues
 - Recruitment and retention
 - Safety training guidelines
 - Observer health and safety regulations
 - Eligibility requirements
- Data Quality
 - Accuracy, precision and bias
 - National Bycatch Report
- **EXPENSIVE!**

WARNING

HARASSMENT OF AN OBSERVER WILL NOT BE TOLERATED!

Under the LAW violators are subject to civil and/or criminal penalties up to 6 months imprisonment and \$130,000 fine.

It is unlawful to:

- Harass or sexually harass an observer.
- Create an intimidating, hostile or offensive environment.
- Impede, bribe, intimidate or interfere with an observer.
- Tamper, destroy or discard an observer's samples, equipment records or personal effects.
- Prohibit or bar an observer from performing duties.
- Refuse to provide an observer reasonable assistance.
- Pressure or coerce an observer to perform crew duties.
- Refuse an observer coverage.

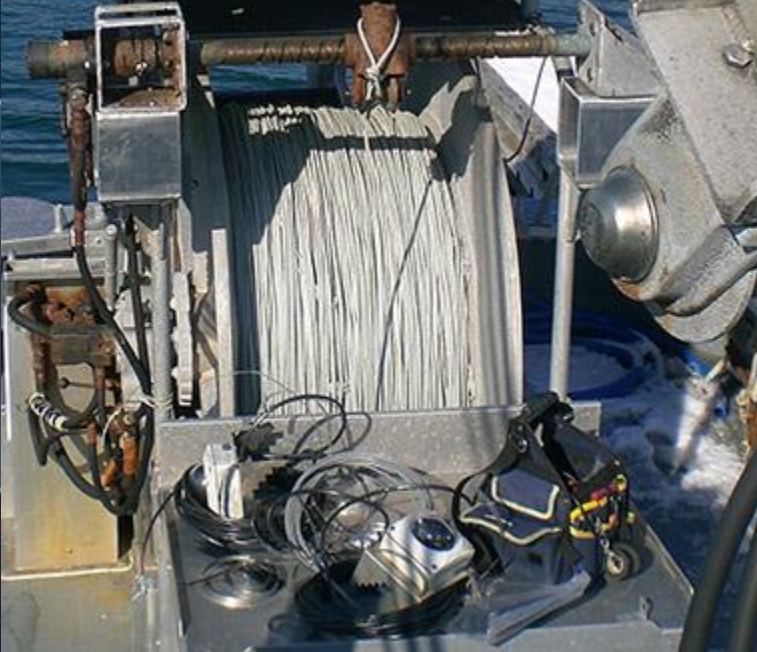
Assault or sexual assault of an observer is punishable by up to 10 years imprisonment and \$260,000 fine.

 **Report Violations to NOAA Enforcement** 
800-853-1964

Self Check

- Fisheries Observers are National Marine Fisheries Service Employees
 - True
 - False
- Fisheries Observers Primary role is enforcement of fisheries regulations
 - True
 - False

Electronic Monitoring



Electronic Monitoring

- Currently, EM cannot collect the same data that observers collect
- EM systems are designed to collect
 - Data about catch and discards
 - Vessel location
 - Fishing activity
- Challenges
 - Accurately identifying all managed species
 - Collecting weights and biological samples from discarded catch
 - Time required to obtain and review video and extract all requisite information.

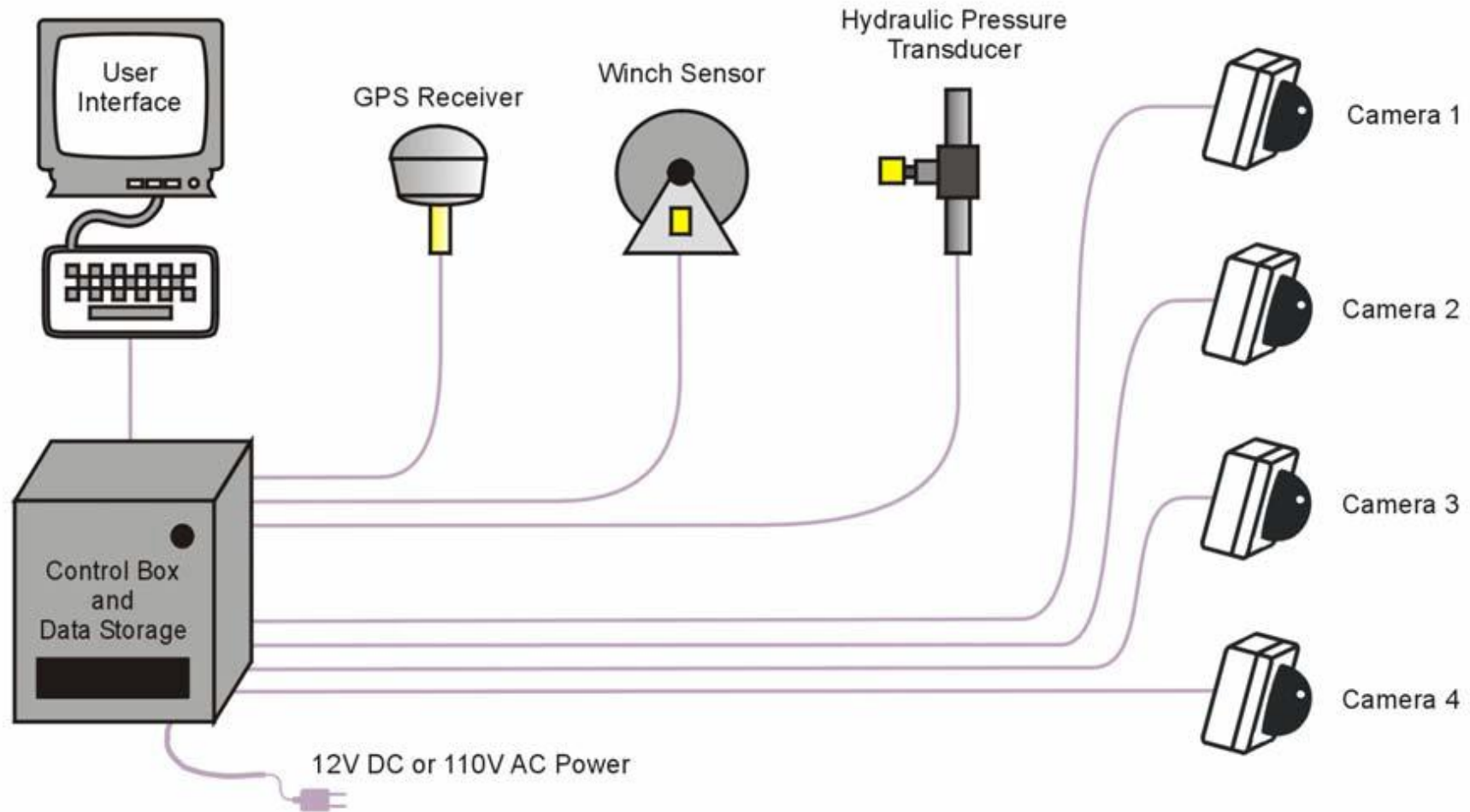
EM System



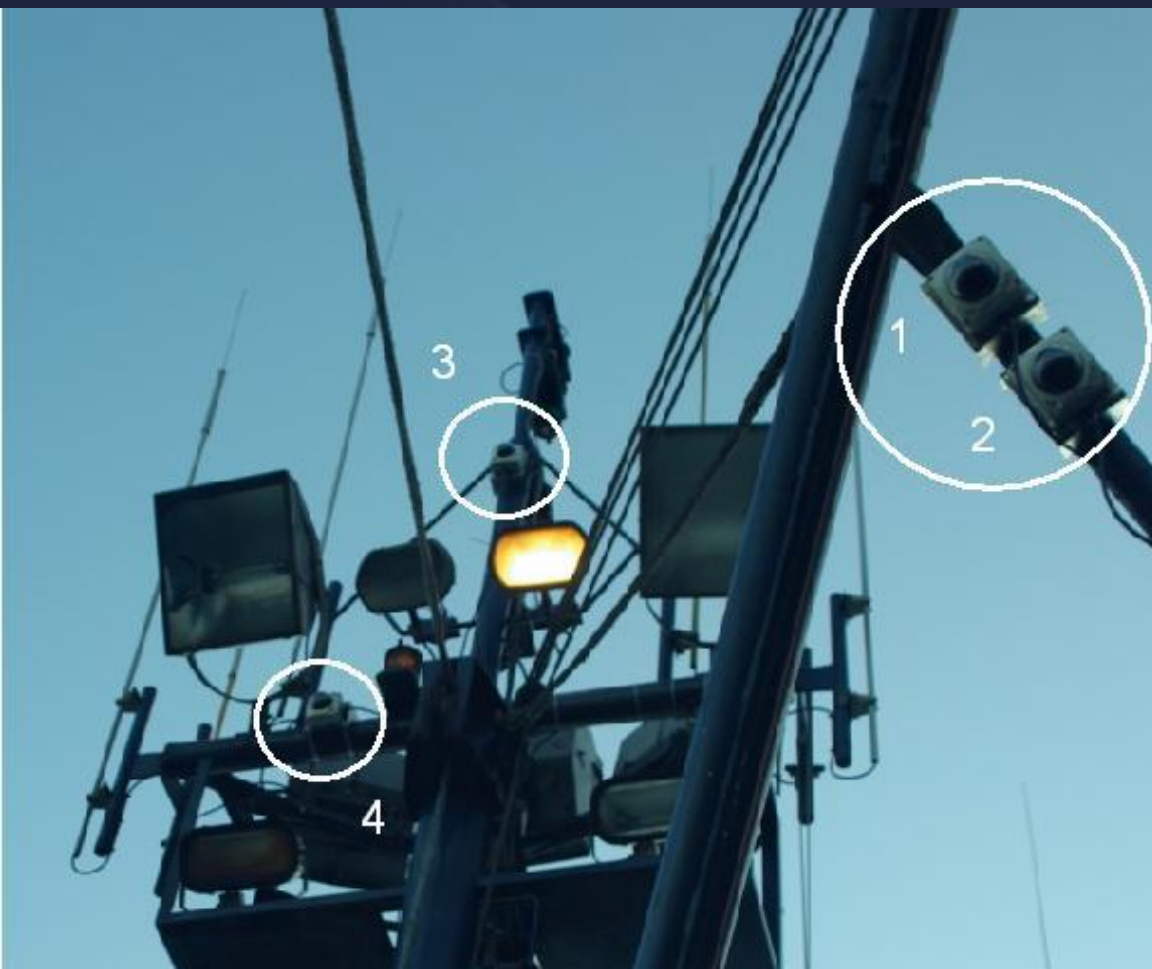
- Cameras
- GPS
- Magnetic rotation Sensor
- Hydraulic pressure sensor



EM System



EM System



EM System

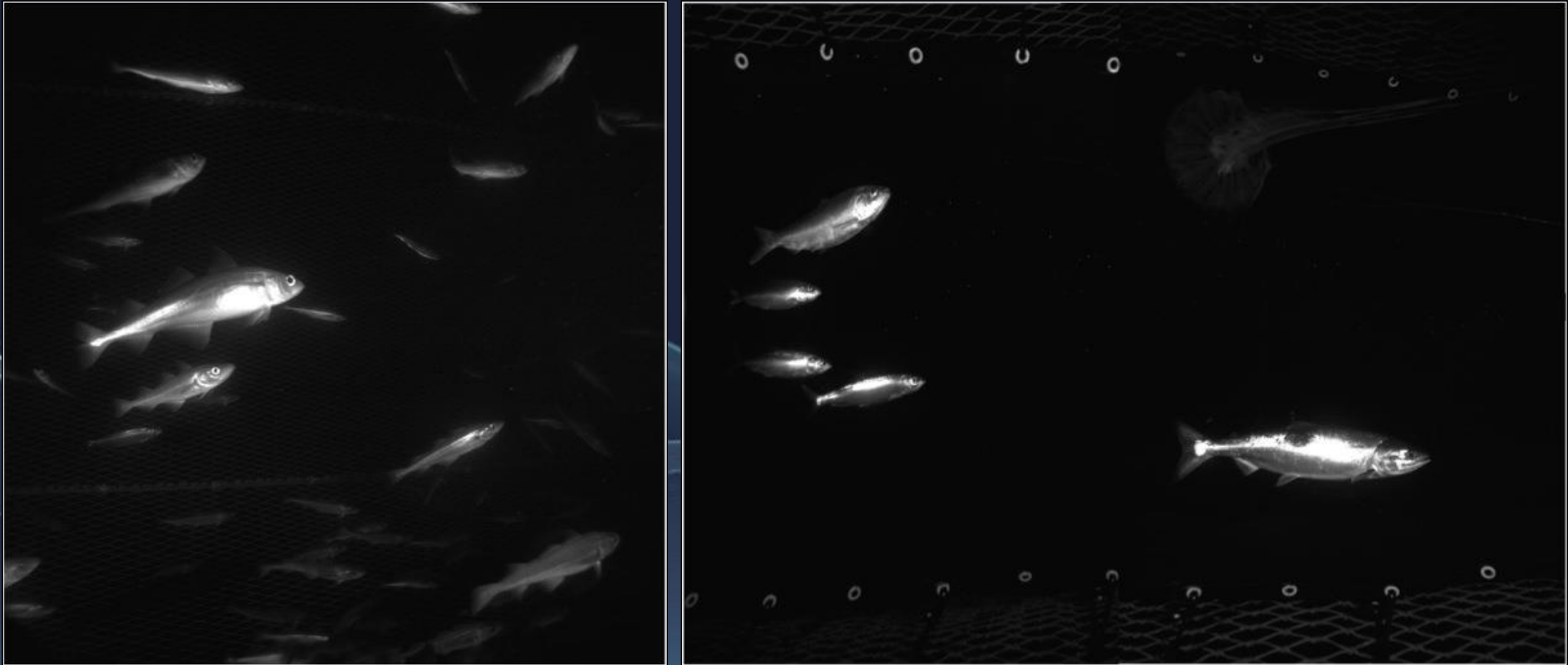


Cam Trawl Midwater



- Cameras in Nets
- <http://teacheratsea.wordpress.com/2012/08/11/allan-phipps-looking-ahead-the-future-of-noaa-fish-surveys-august-10-2012/>

Cam Trawl



Stereo Cameras in the trawl

Cam Trawl

- Stereo Cameras allow lengths to be estimated
- Lengths can be applied to LW data
 - Estimate Biomass
- Fish trawl with open cod End
 - 0 mortality ground truthing of acoustic surveys
- Some fish would still need to be retained
 - Sex & LW relationships
- What about catcher vessels



Video Recognition

- Facial recognition (Homeland Security)
 - Used to recognize and measure fish
- Digital video cameras record all fish brought onboard /discarded as bycatch.
- Computers identify species
 - Estimate weight
- Allow computers to tally the catch for each species.

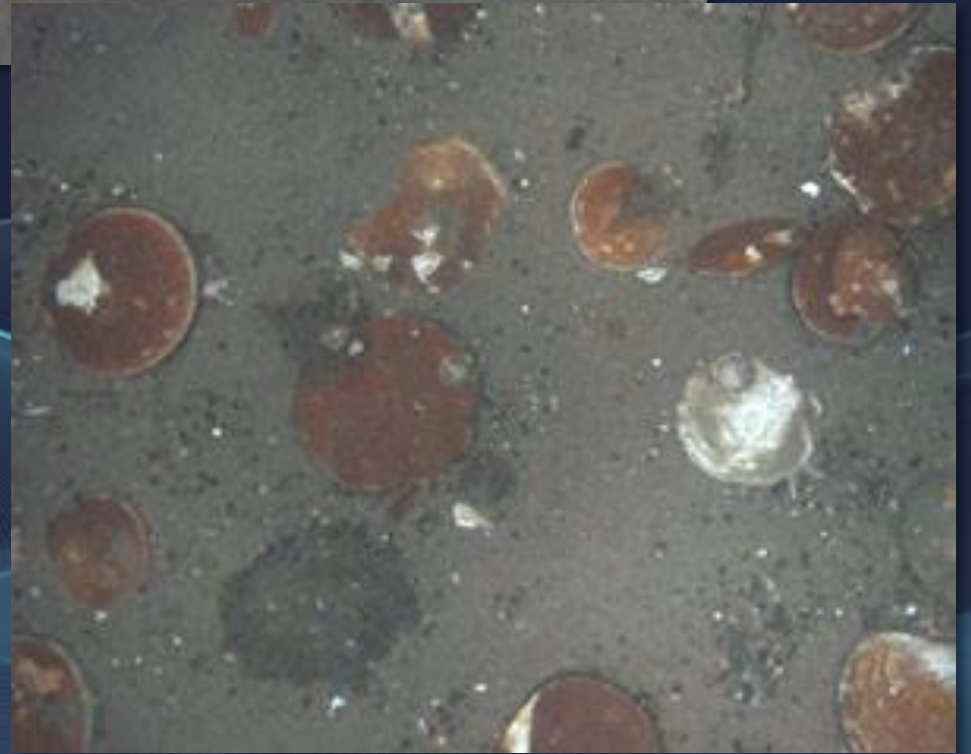
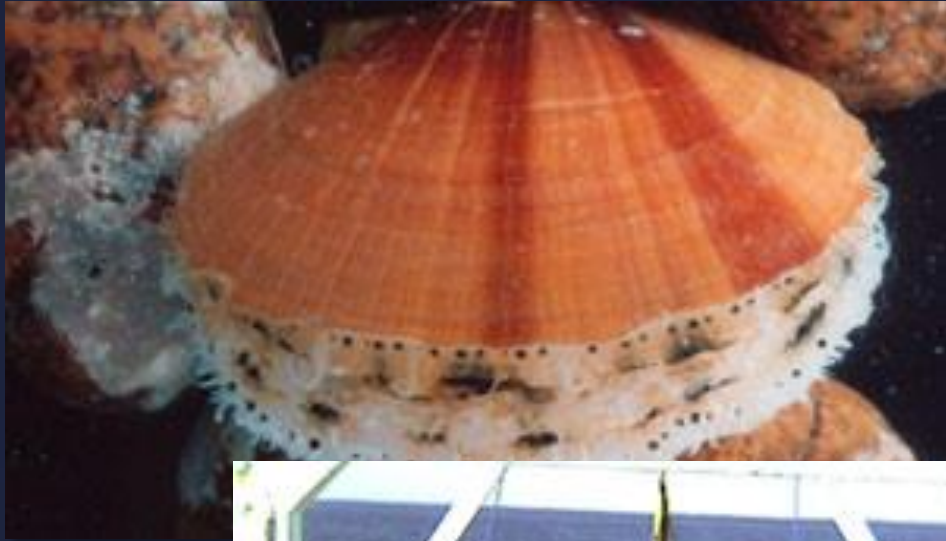
Hab Cam Benthic

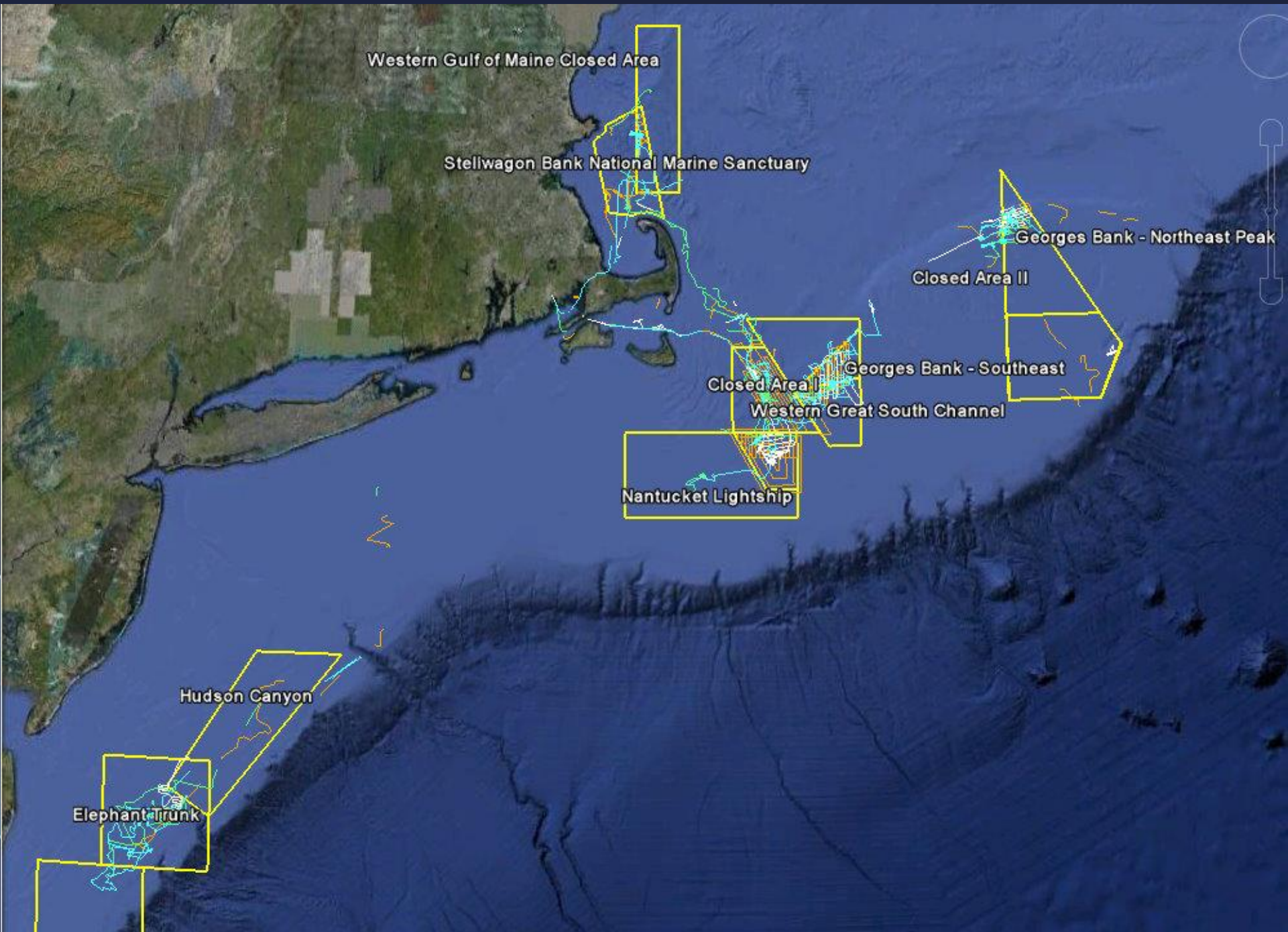


Hab Cam

- Video survey of Atlantic scallops
 - Also Tested in Alaska
 - Lasers
- Biomass estimates of scallop populations
 - No Damage to Habitat!
 - Typically trawl
 - Go over things you cant trawl
 - Still don't want to get hung up

Hab Cam





Stationary Video Camera Array

- Gulf of Mexico
- 3D stereo camera arrays
- Survey fish populations on deep reef habitats
- Difficult or destructive to survey using traditional means.
- Determine fish lengths – stock assessments.



Self Check

- It is possible to acquire fish lengths using cameras
 - True
 - False
- The above picture is of what type of electronic monitoring system
 - Trawl Cam
 - Hab Cam
 - Stationary Video Camera Array
 - Electronic Monitoring Array
 - None of the above



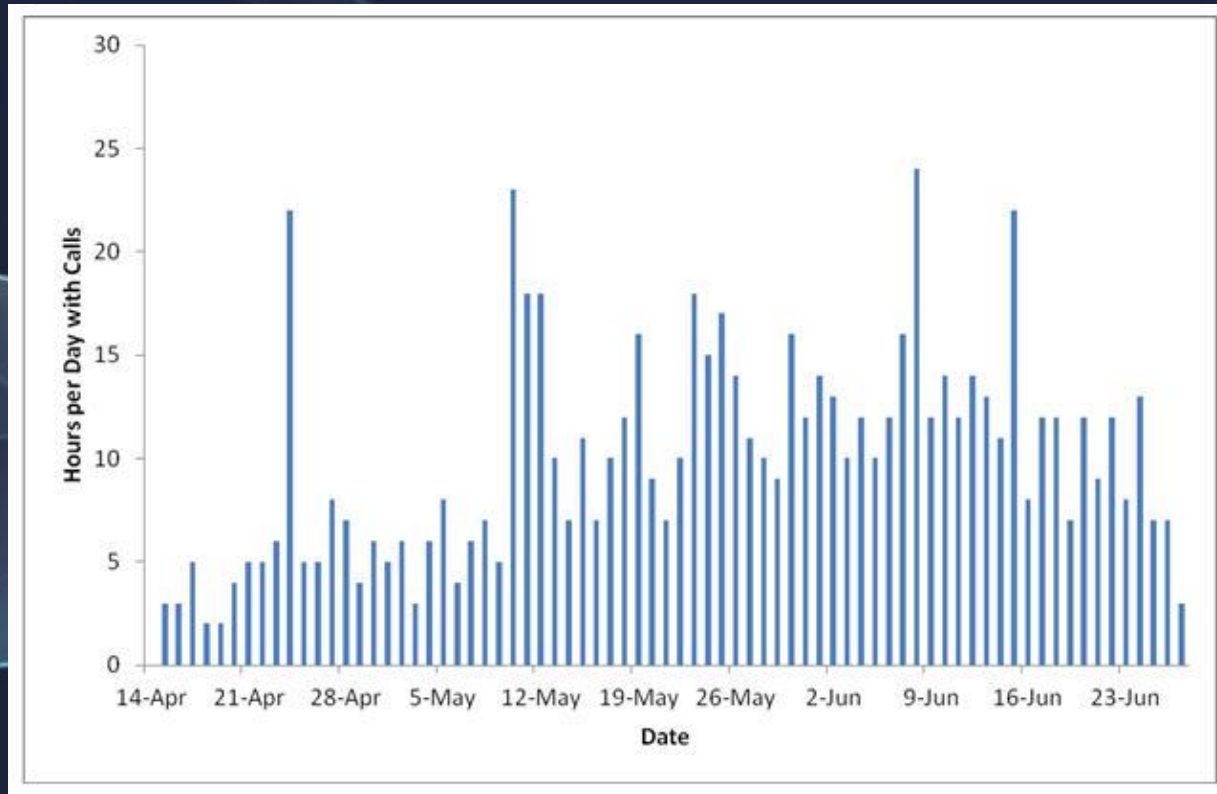
Acoustics

‘Listening to noises’

- Acoustic Monitoring of Atlantic Cod Reveals Clues to Spawning Behavior
- 100 families of fish produce sounds
 - Haddock (*Melanogrammus aeglefinus*)
 - Pollock (*Pollachius virens*)
 - Atlantic cod (*Gadus morhua*)
- Male and Female cod Produce low frequency "grunts"
 - Male Atlantic cod make this sound during spawning season

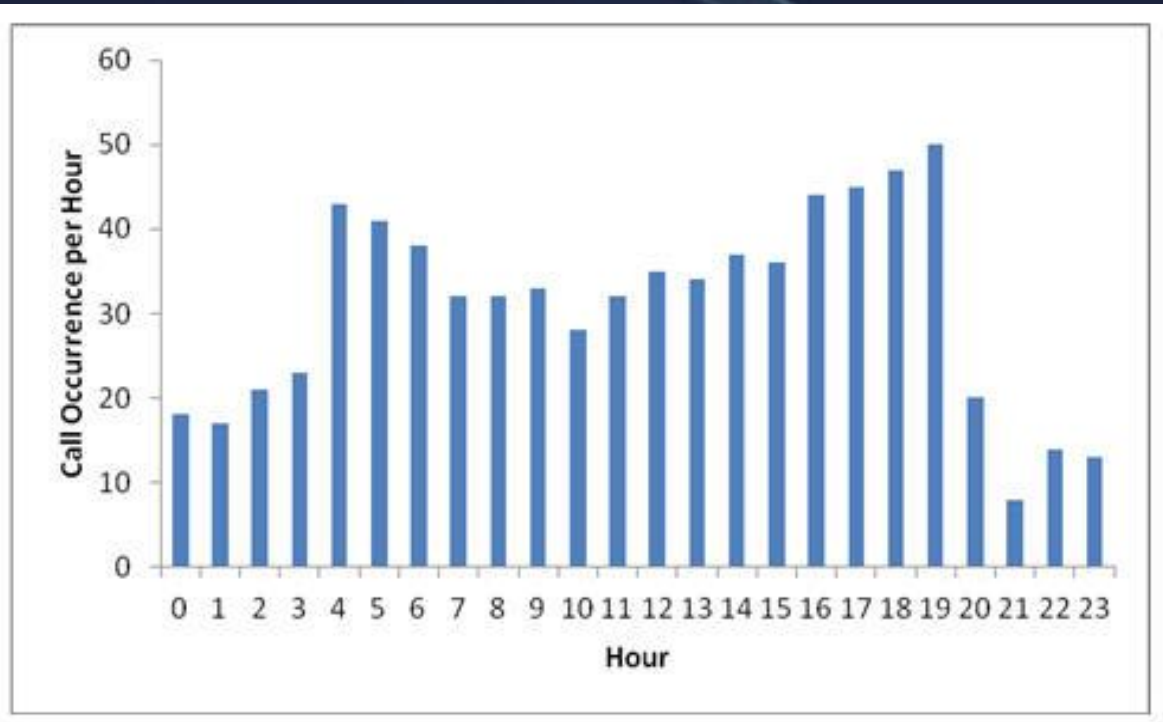
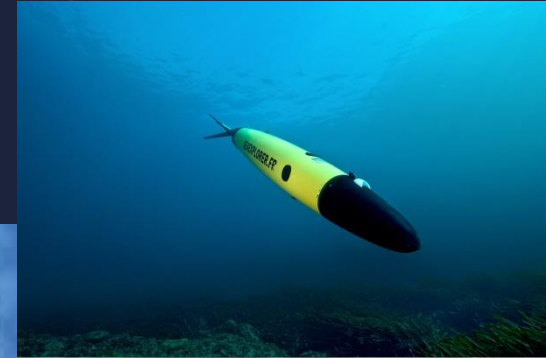
Acoustic Array Atlantic

- Initially deployed acoustic buoy array
 - Were able to locate Atlantic cod spawning grounds & Timing



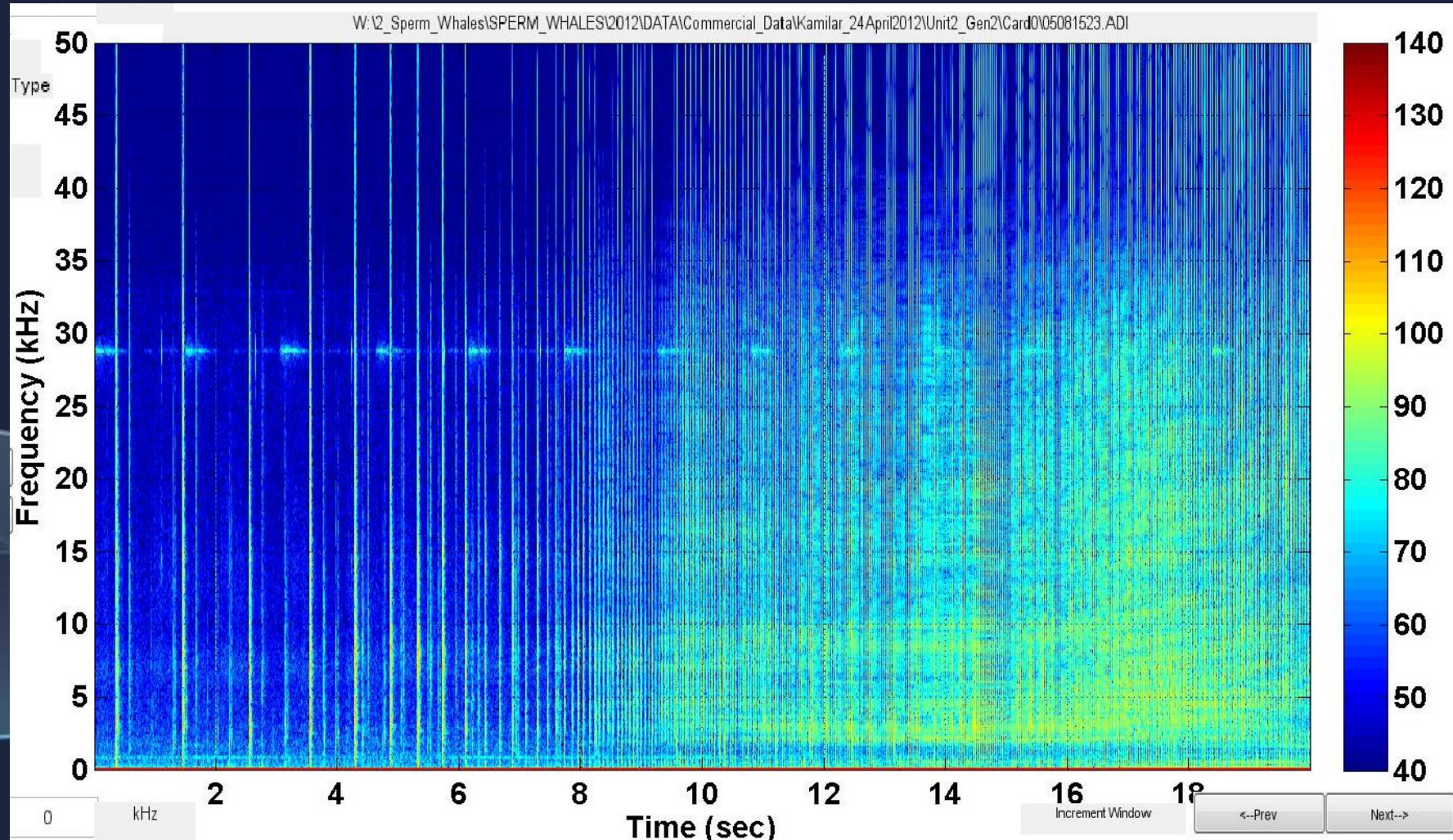
Glider Cod Acoustic Monitoring

- More detailed coverage of Spawning
 - Spawn in evening



Sperm Whale Sounds

Creak



Longline Perdation



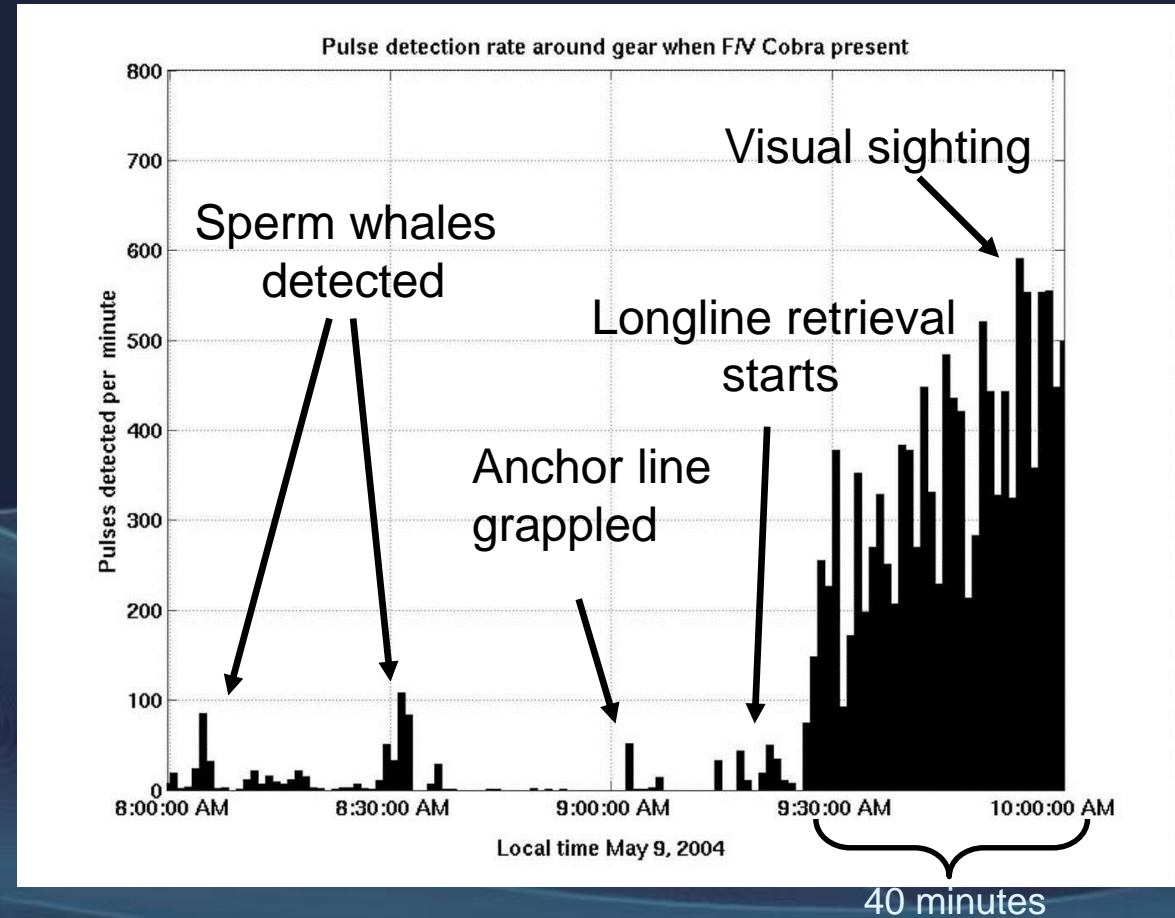
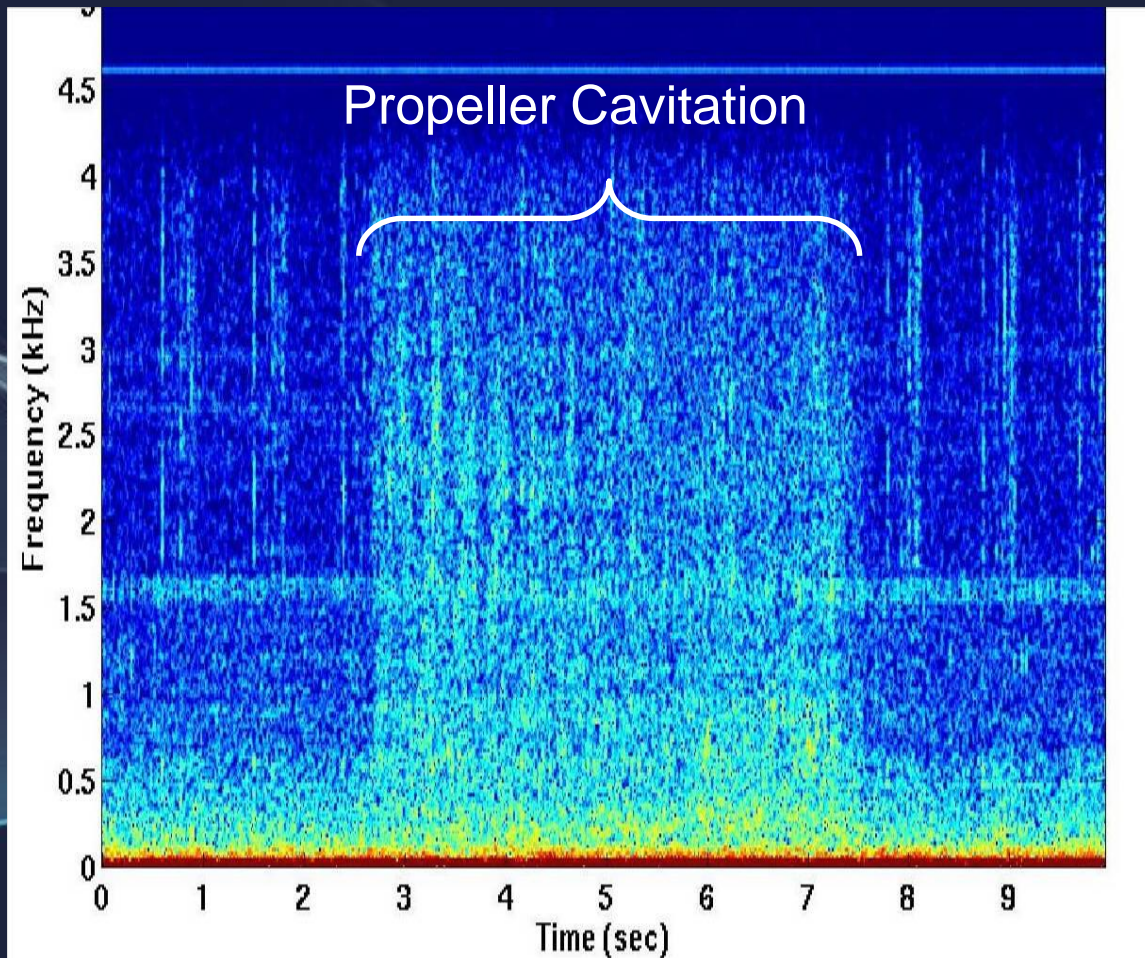
Sperm Whale / Fisheries Interaction:



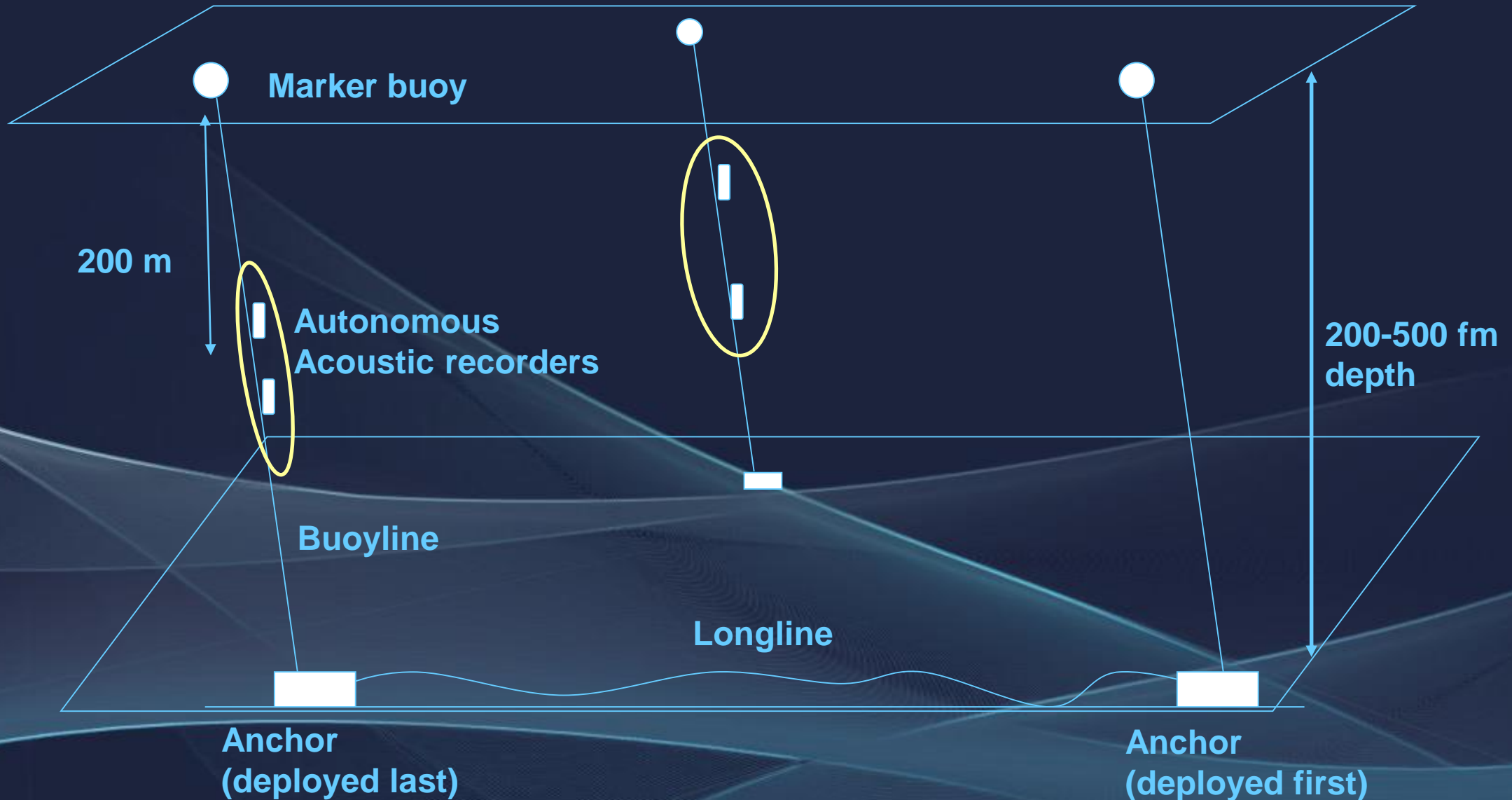
https://www.youtube.com/watch?v=5panVo_3oVQ

Acoustic Cues: engine cycling

- When engines begin to engage, sperm whale click rates increase rapidly.



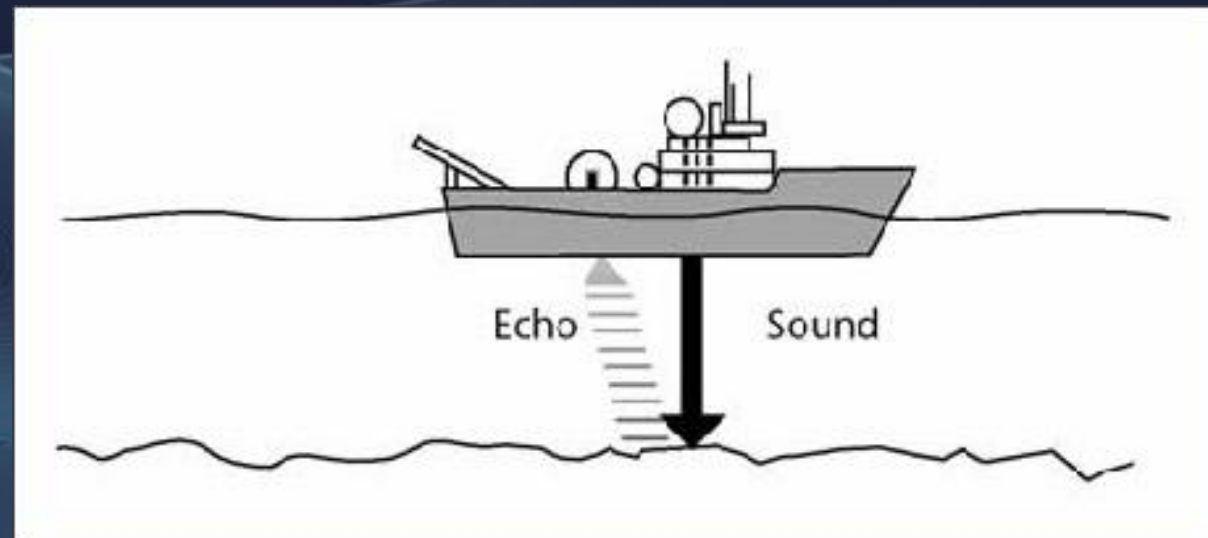
SEASWAP : Acoustic research



Hydroacoustics

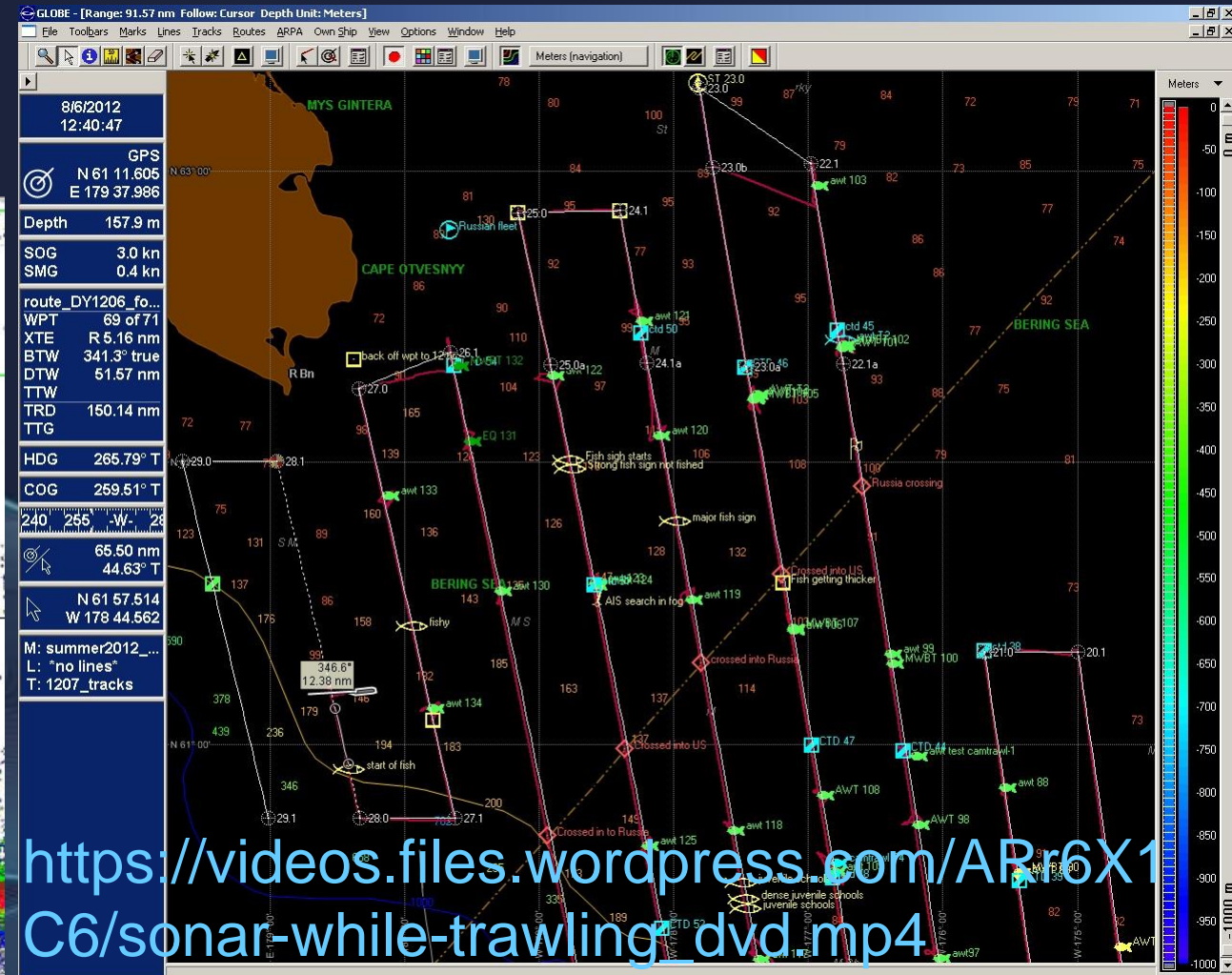
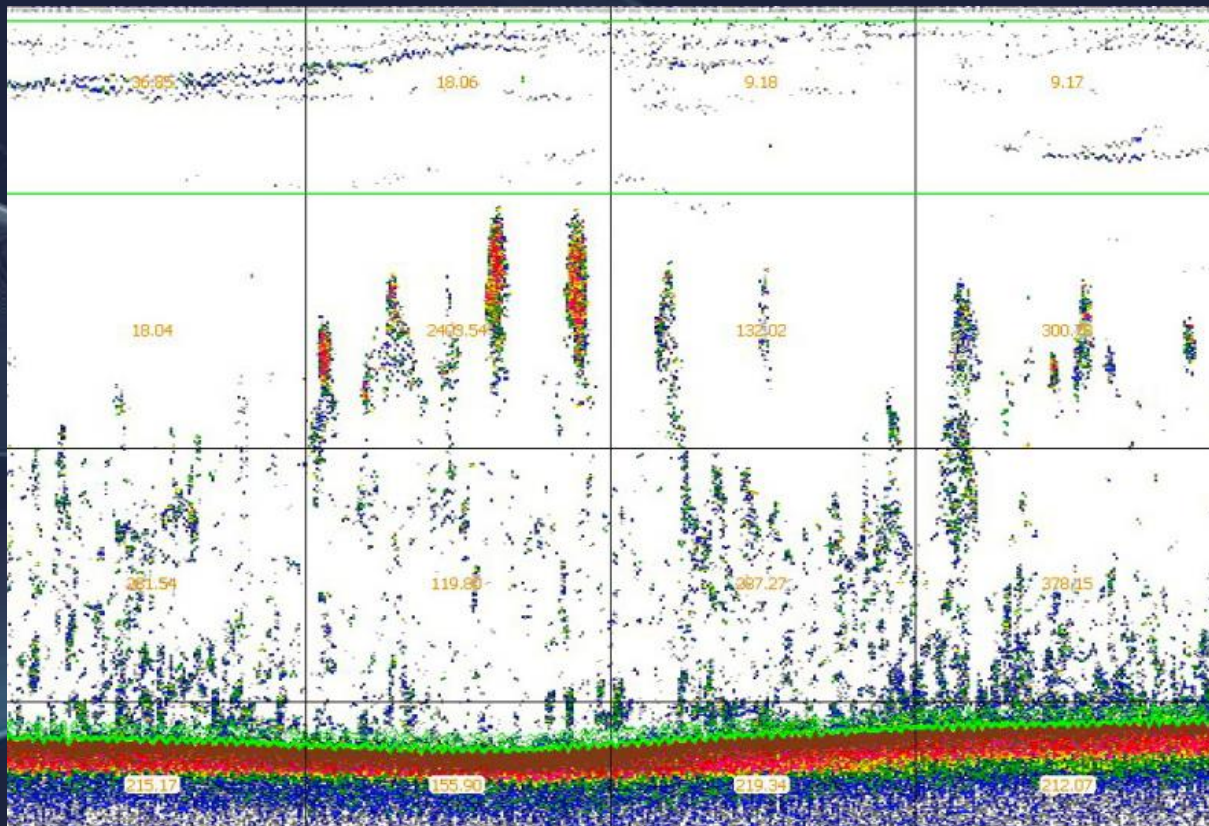
Hydroacoustics or SONAR (Sound Navigation And Ranging)

- Send a sound wave out and measure the echo that bounces back
- Similar to Depth Sounder on small boat
 - Just way better
- Fish swim bladders produce a strong signal
 - Can measure intensity of signal



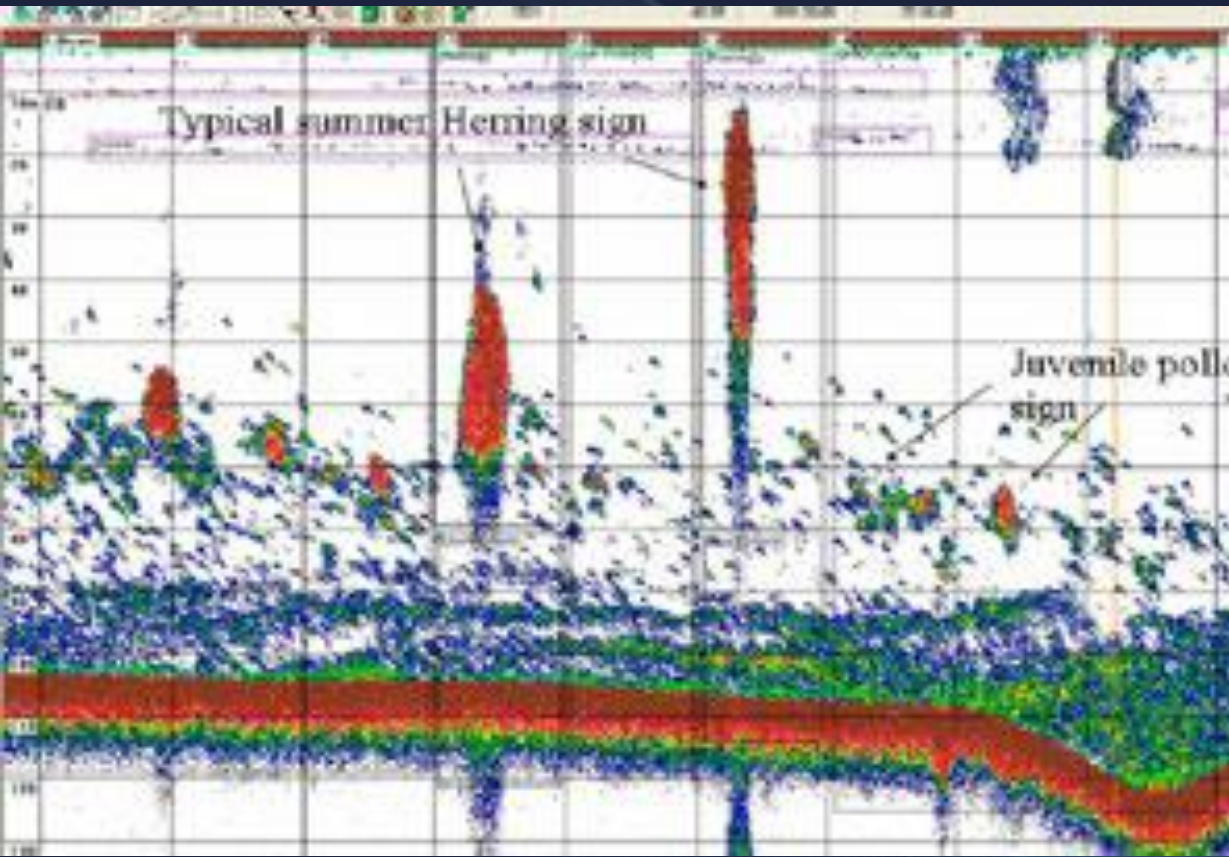
Hydroacoustic Surveys

- Record signal strength of echo
- Follow transect lines

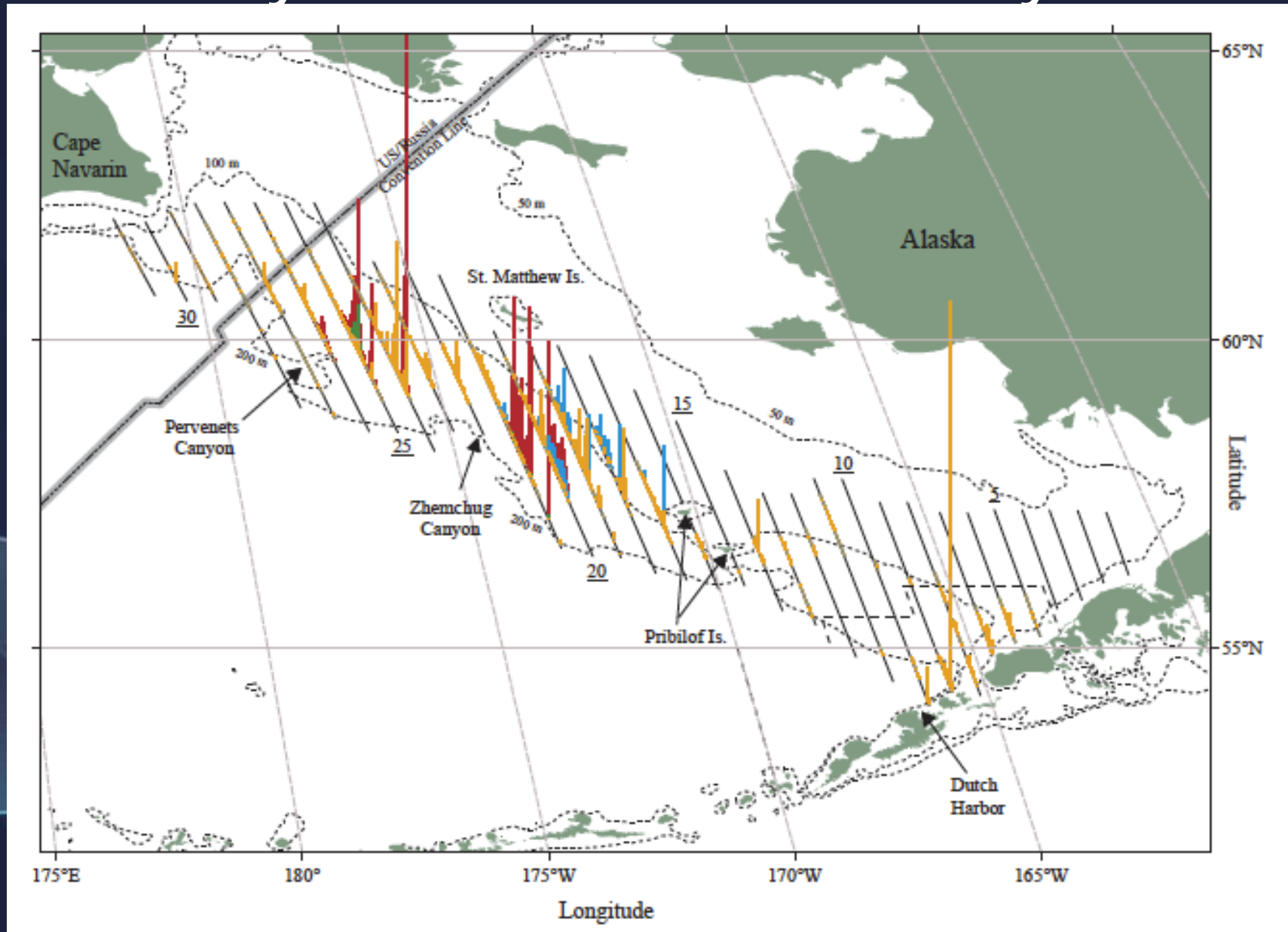


Hydroacoustic Surveys

- Used to assess the biomass of various fish species
 - Herring
 - Pollock & Cod



Hydroacoustic Surveys



ADF&G Hydroacoustics

SE Herring Surveys

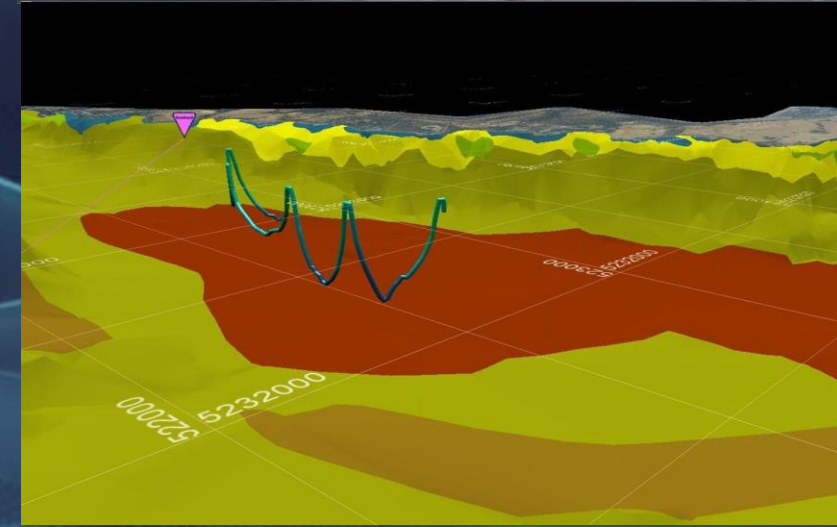


Self Check

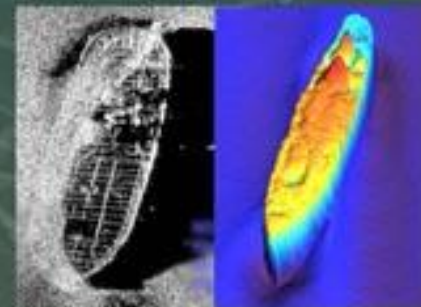
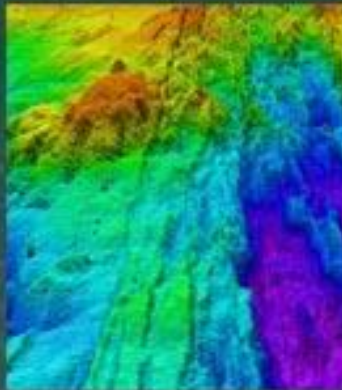
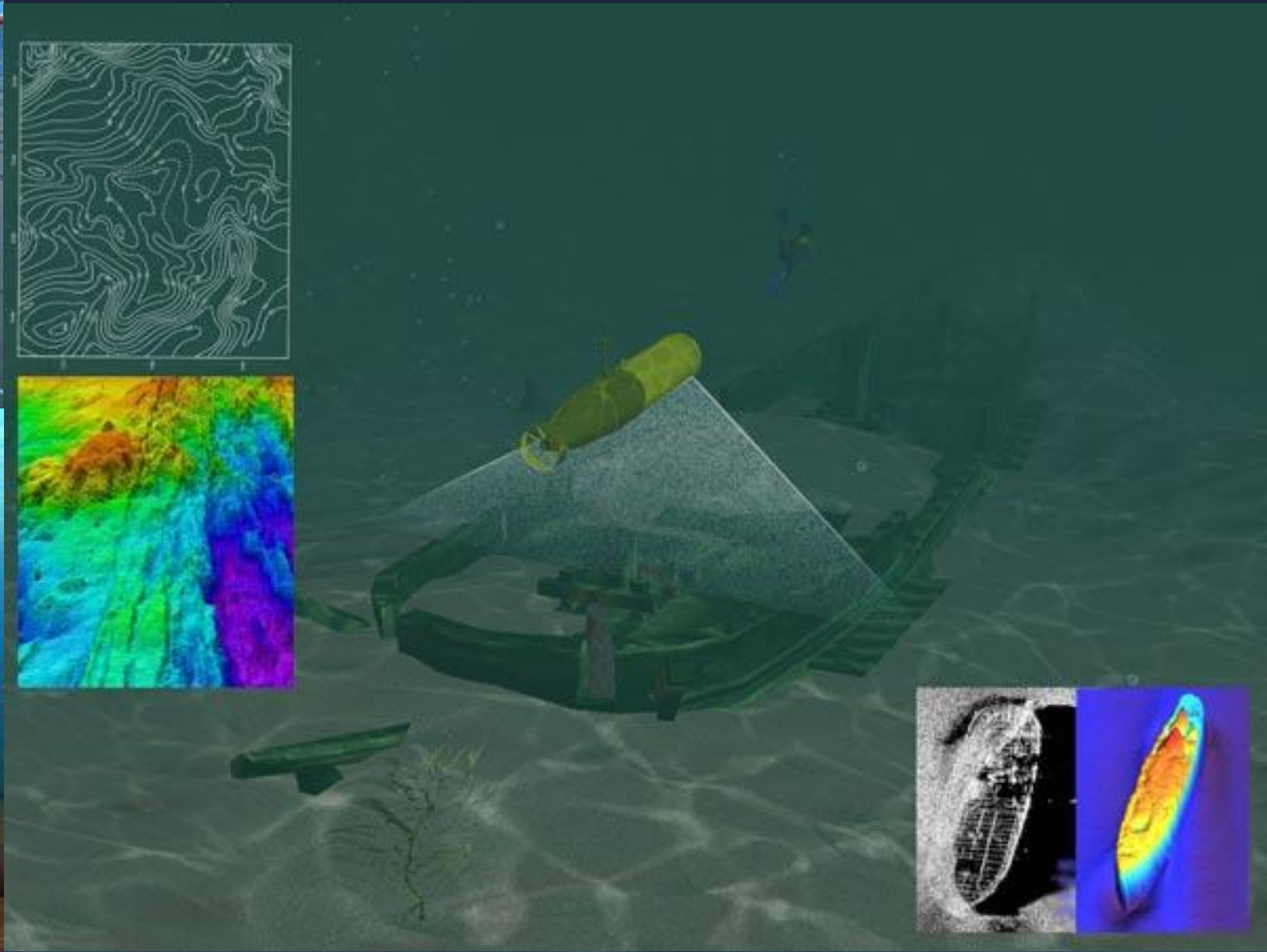
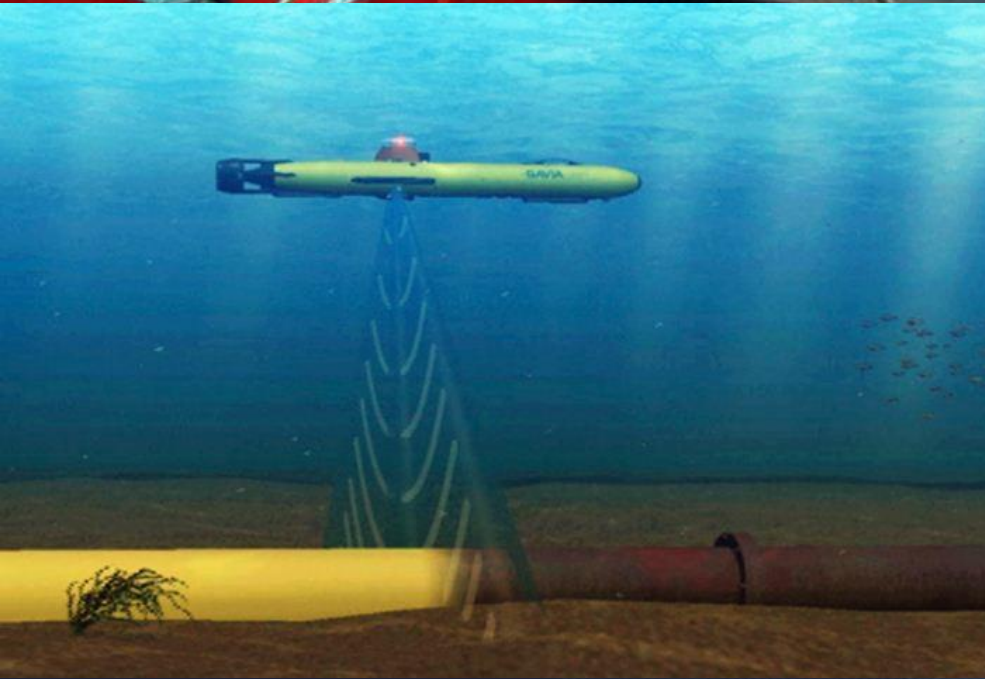
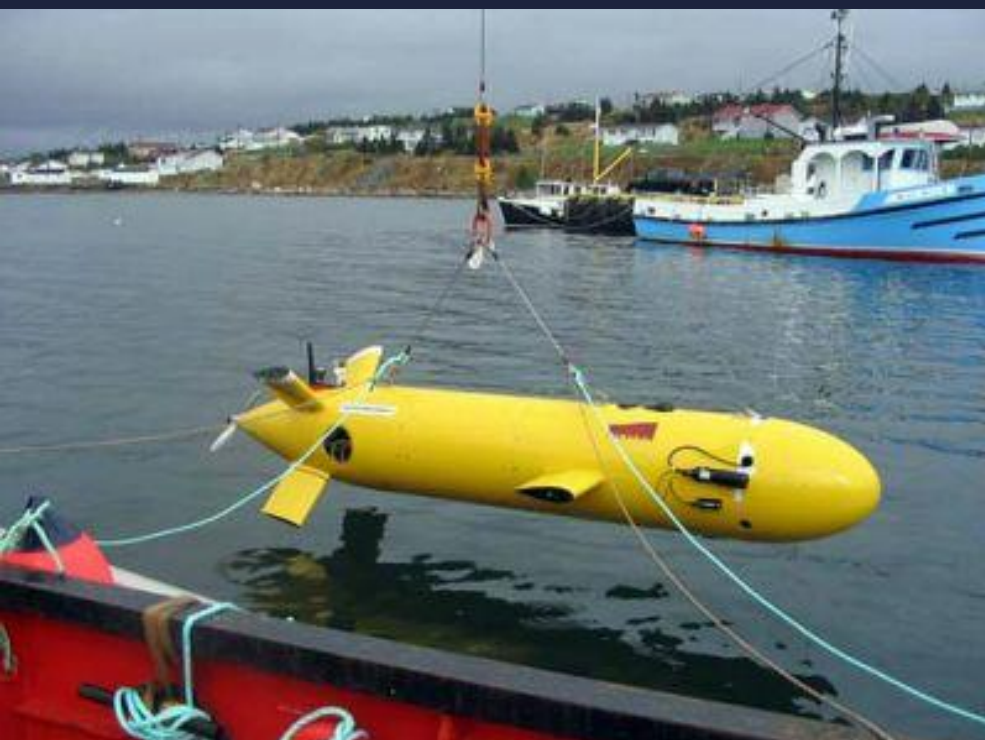
- Hydroacoustics is the science of listening to noises underwater
 - True
 - **False**
- Sperm whales cue in on what part of the boat to steal fishermen's catch?
 - Engine running
 - Propeller spinning
 - **Transmission going in & out of gear**
 - Hydraulics running
 - None of the above

Autonomous Underwater Vehicle (AUV)

- An underwater robot that follows out orders without external input from humans
 - Autonomous
- Oceanographic sensors
- Acoustic/Hydroacoustic sensors
- <http://vimeo.com/101165012>



AUV's



Drones

Fish and Game of Drones

- Using unmanned aerial vehicles to study salmon and habitat
 - Safety
 - Low-impact, non-invasive
 - Sustainability
 - Portable and convenient

Safety

- As scientists we fly all types of surveys
- Most are in remote locations
- Often in marginal and sometimes poor weather



TUESDAY, AUGUST 31, 2010

Biologists, pilot killed in Kamiah helicopter crash

A helicopter chartered by the Idaho Fish and Game Department agency plunged into a travel trailer and crashed today on a downtown street in the small town of Kamiah, killing two fisheries biologists and the pilot, authorities said.

Drones & Fisheries

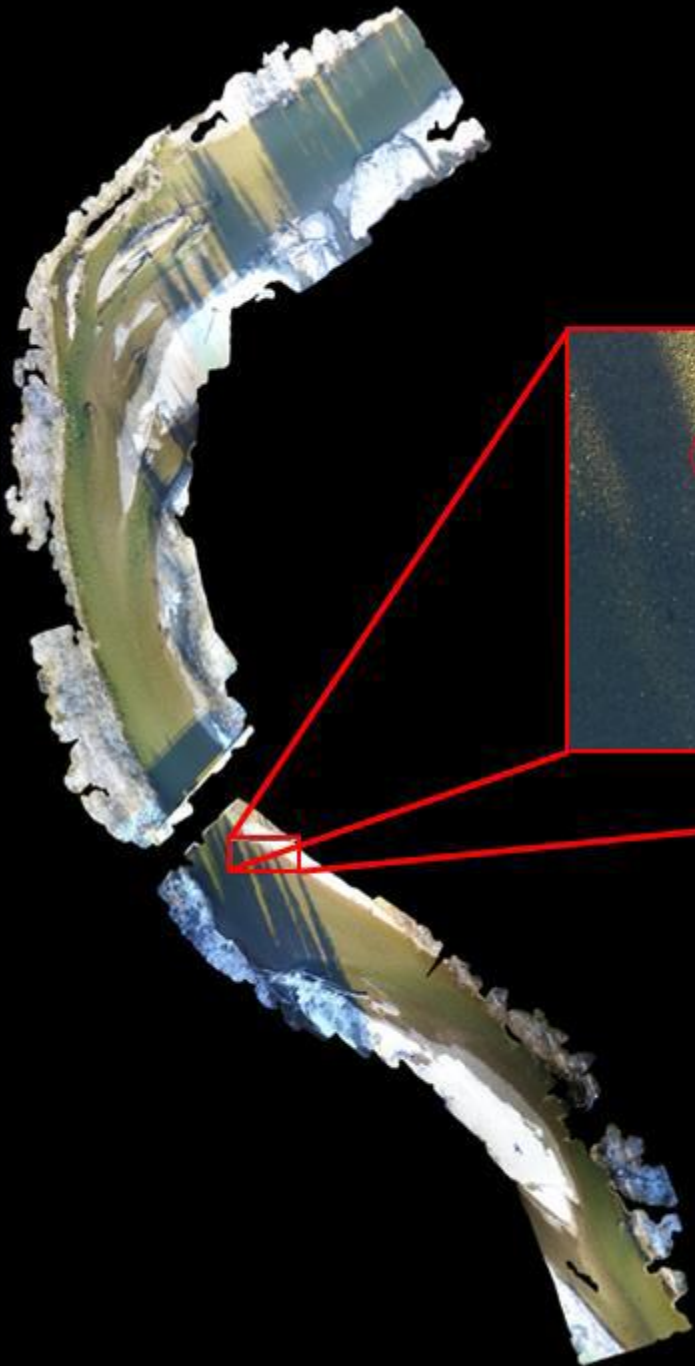


Relative UAV Specifications

- Weight (incl. batteries and propellers) 1280 g (2.8 lbs.)
- Diag. Size (incl. propellers) 590mm (23.2 in.)
- Operating Temp. -10°C to 40°C (14°F to 104°F)
- Camera resolution 12.76M
- Max flight time is approx. 23 minutes
- Range 2000 meters (1.24 miles)



Salmon decoys seen in
an enlargement of the
orthomosaic



Drone Video

- <https://vimeo.com/144195684>



Self Check

- Both Drones and AUV's are limited by the range at which pilots can fly and communicate with the vehicles
 - True
 - False
- One of the primary benefits to the use of Drones is Safety
 - True
 - False

Homework

- Find a new management tool and post an article, link, or video on the blackboard discussion page
- Include a brief description and how you think it could be utilized in fisheries management
- **Due Before Next Class!**

Good Night

The background features a dark blue gradient with several overlapping, flowing lines in lighter shades of blue and teal. These lines create a sense of movement and depth, resembling waves or abstract patterns. The overall aesthetic is clean and modern.