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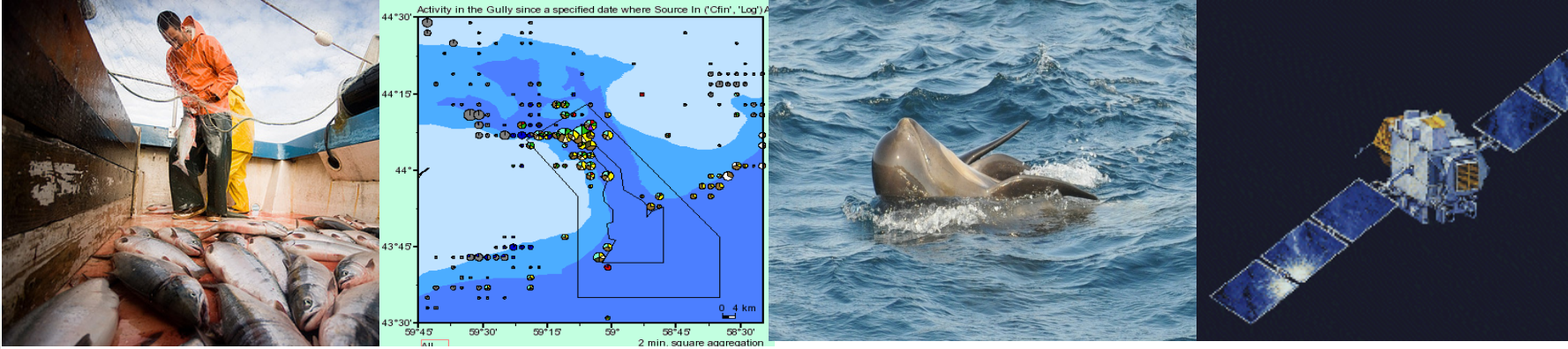
Biodiversity: is innovation the cure?

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Technologies for Surveillance and Enforcement in Marine Areas

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**Biodiversity:
is innovation
the cure?**



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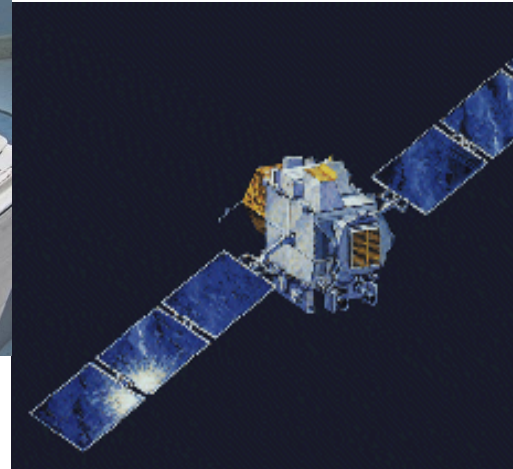
Maritime Areas vary by:

- Size (some are thousands of km²)
- Jurisdiction – state vs. high seas
- Distance from shore
- Types of regulations
- Primary challenges – fisheries, pollution, IUU
- Quantity and type of vessel traffic
- Access to assets and funds



Surveillance approaches

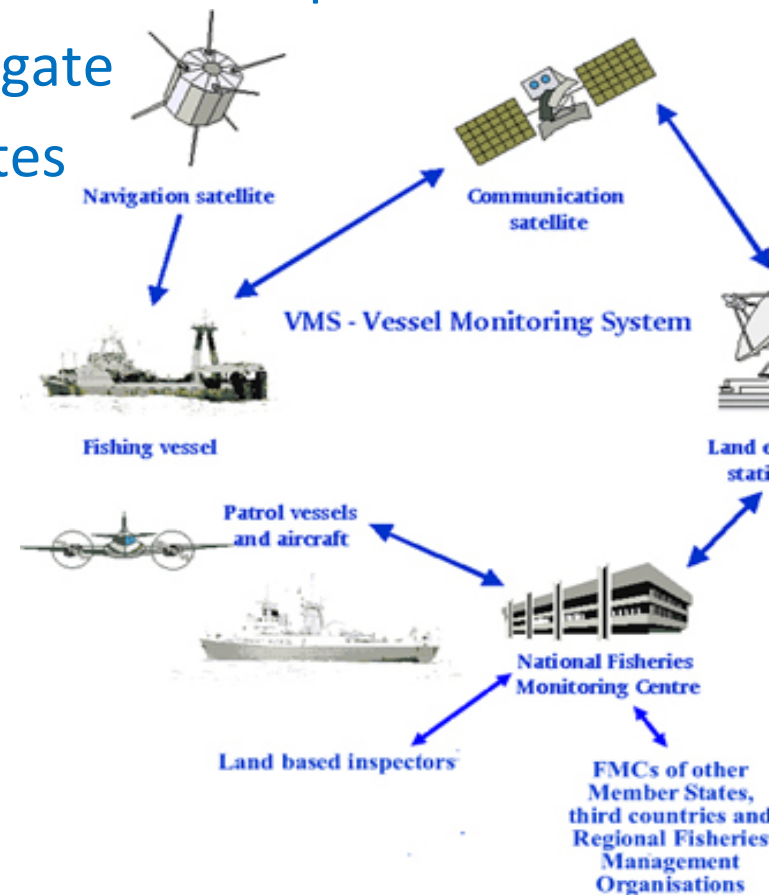
- Cooperative vs. non cooperative
- Classified vs. civilian
- Ground, sea, air or space-based
- Continuous vs. periodic
- Manned vs. unmanned



Vessel Monitoring Systems (VMS)

- Device on vessel sends signal to satellite showing vessel heading and speed in real time
- Ground stations alert enforcement about suspicious activities
- Enforcement can choose to investigate
- VMS in common use in many States

BUT – VMS is not tamper-proof



Electronic Monitoring Systems (EMS)

- Video cameras on board monitor fishing activities, catch handling
- Sensors may also be placed on winches etc.
- Video analysis is labor intensive and 'after the fact'
- Less expensive than observers
- Can be tampered with

Technology used in BC longline and crab fisheries, in NZ to monitor cetacean interactions and pilot projects underway elsewhere



Automatic Identification Systems (AIS)

- Uses shipboard VHF broadcasting system
- Designed for vessel tracking and identification, but additional channels for other data streams
- Not generally used for fisheries monitoring

Why?

- IMO rule: only vessels >300 GT are required to carry class A AIS
- Land or sea-based systems have limited range (20-100 nm)

But

- There is potential for expansion of AIS for maritime surveillance
- Space-based AIS expands coverage capabilities

Non Cooperative surveillance

Platforms

- Space-based – satellites
- Aircraft – manned and unmanned
- Vessels - manned and unmanned
 - Land or buoy-based

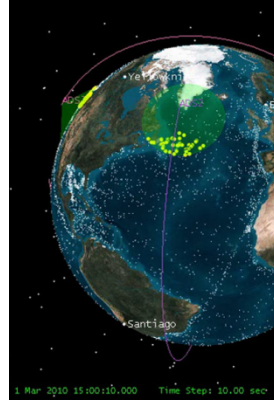
Sensors

- Visual imaging systems
 - Radar systems
 - Acoustics

Surveillance systems use a combination of platforms and sensors to fulfill specific requirements

Satellite-based surveillance

Satellite technologies capture information from a target on earth and relay data back to a control centre



Advantages: Large scale, high resolution images

Disadvantages: Surveillance not continuous, images are expensive and some systems are sensitive to weather and light

Types of sensors

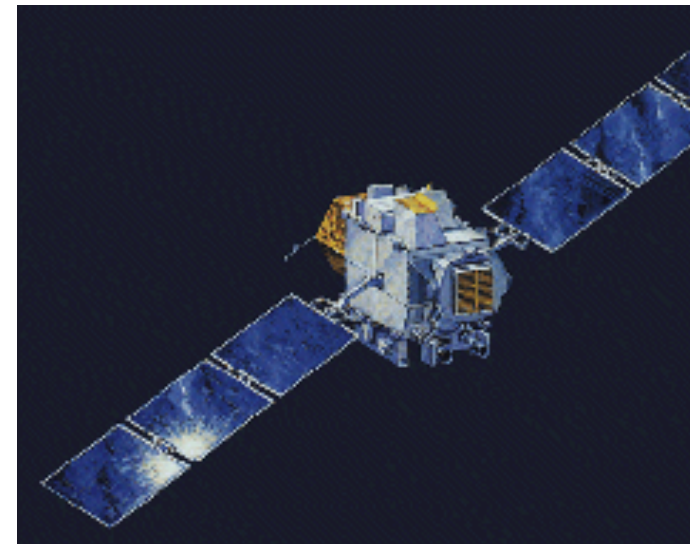
Visual imaging

Optical and IR cameras

Radar

Synthetic aperture radar

Space-based AIS



Manned aircraft

Surveillance of remote or large marine areas requires long range aircraft

Expensive to purchase, maintain and operate - cost sharing between agencies can offset costs

Canada and UK use commercial contractor on per mission basis.

Aircraft can be equipped with a great variety of sensors including radar, SAR, visual and/or IR cameras, and more specialized sensors for pollutants



Unmanned Aerial Vehicles (UAVs)



US Navy MQ-8B
fire scout rotorcraft



US Coast Guard
Bell Eagle



MQ-9 used by US and
British armed forces

Payloads can include visual and/or IR cameras, biological or chemical sensors, and radar

UAVs can fly extended missions (8 to >48 hours)

Most are currently operated by military

Problem with operating UAVs in national airspace

Manned Patrol Vessels

Most common approach to maritime surveillance and enforcement

- Range of vessels limited to line of sight even with radar
- Coverage of large areas not practical or cost effective

Use other technologies for broader surveillance and manned vessels for interdiction



Land or buoy based platforms

Airships, aerostats and helikites

Can be deployed from land, ships or vehicles

Can be tethered or untethered, very small or very large

Used for visual sensors and transceivers, including AIS

Moorings and buoys

Seabed underwater mooring systems

Buoys with acoustic packages

Some systems can relay data in near real-time

Cannot identify individual vessels, but may identify activity



Crowdsourcing

- Cell phones – can capture geo-referenced images and transmit messages to LE or intermediate coordinator
- Tip-lines used by enforcement agencies, often with reward
- MPA Guardian and EPIC 805 programs are crowdsourcing efforts that use cell phone apps to enable volunteers to document and report MPA violations in California USA
- Cell phones were issued to local people in Senegal to report MPA violations.



Data Fusion

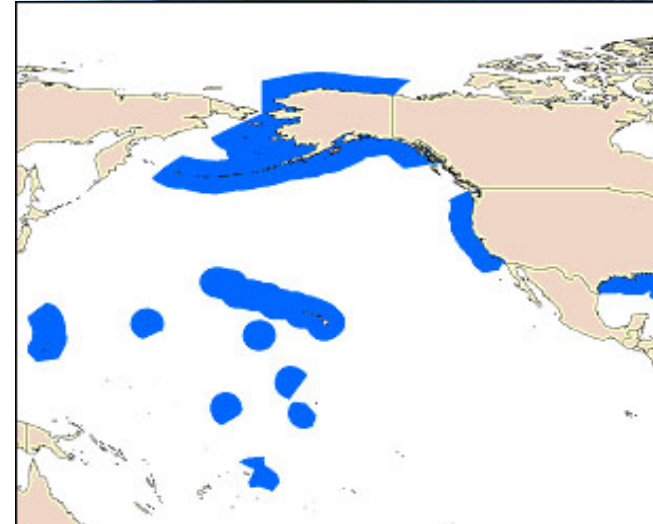
Most surveillance systems consist of multiple data sources

Examples:

Satellite SAR, VMS and AIS

Airborne visual imagery, VMS, acoustic data

Data streams have to be integrated into a usable and visually intuitive format for use by LE personnel.





The following document contains more details on surveillance technologies:

Brooke SD, Lim TY, and Ardrone JA (2010) Surveillance and enforcement of remote maritime areas. Paper 1: surveillance technical options. Marine Conservation Biology Institute, USA. 37 Pages.

<http://www.marine-conservation.org/news/publications/>

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