Using moored passive acoustic recorders to assess seasonal occurrence and movements of Southern Resident Killer Whales in US coastal waters

Brad Hanson

Candice Emmons

Northwest Fisheries Science Center

Jeffrey Nystuen

Marc Lammers

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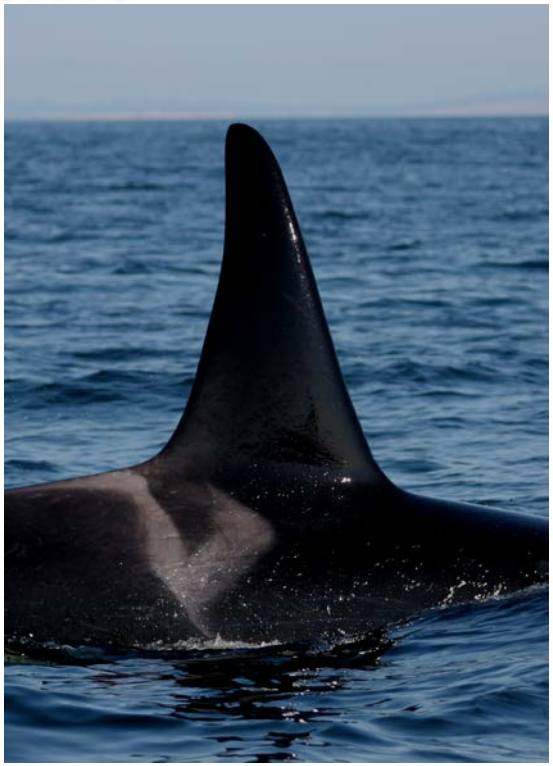
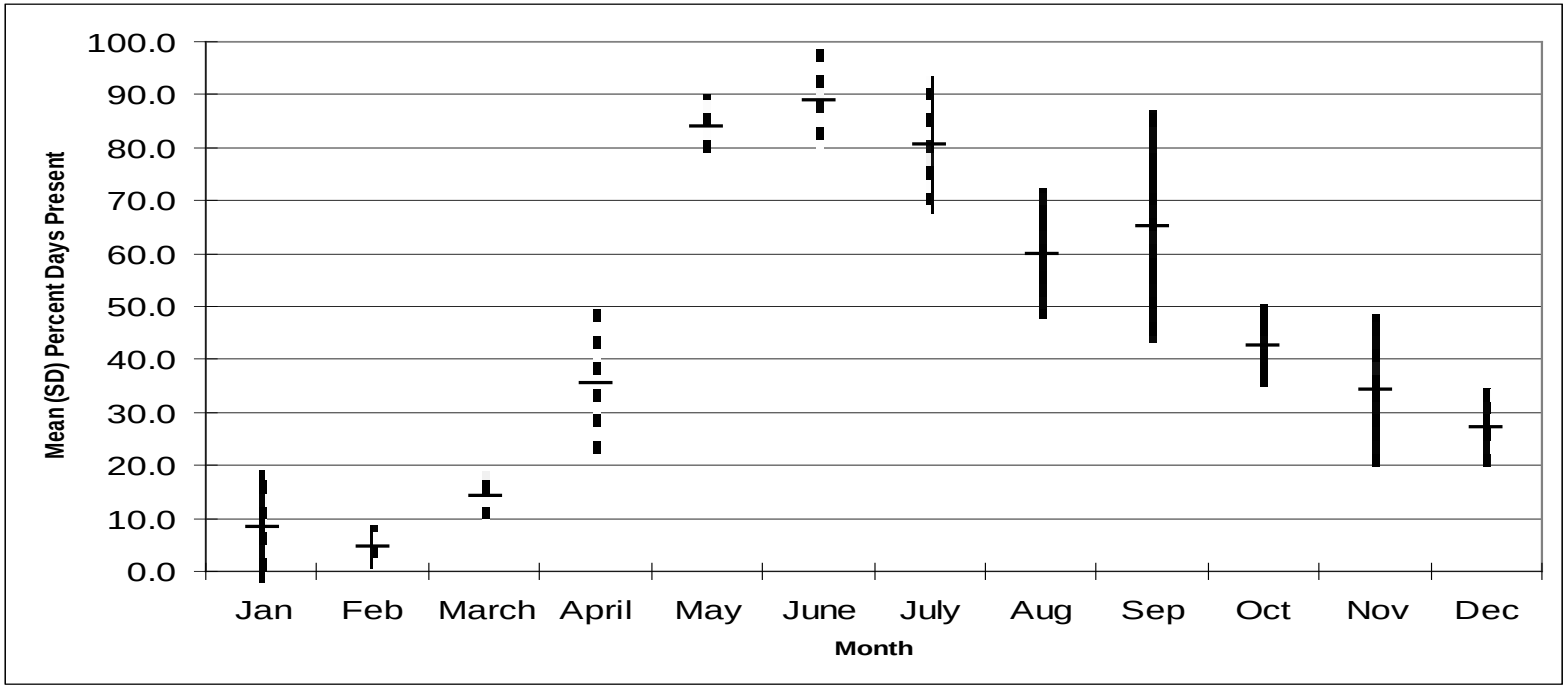


Southern Resident Killer Whale Critical Habitat designation

At least 1 of the 3 pods are typically “resident’ in inland waters of Washington and British Columbia during the summer months



In November-January SRKWs leave inland waters and only return infrequently until May

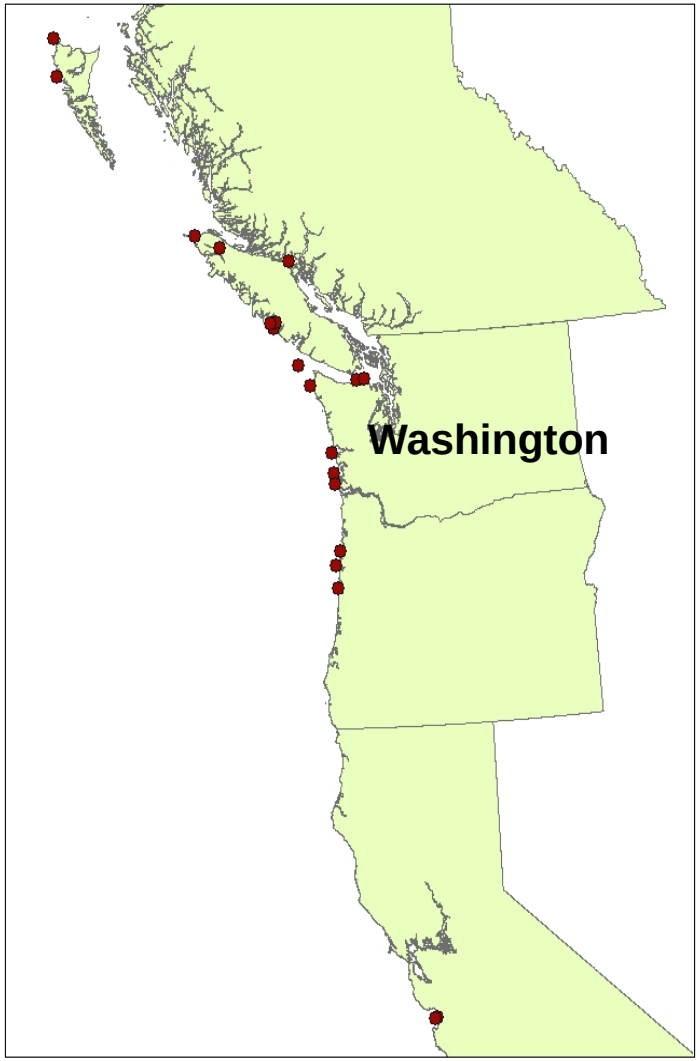
Known Range of Southern Resident Killer Whales

In 2005 SRKW range was based on 19 sightings collected 30 years

6 locations off Washington coast

3 locations off Oregon

2 locations off California

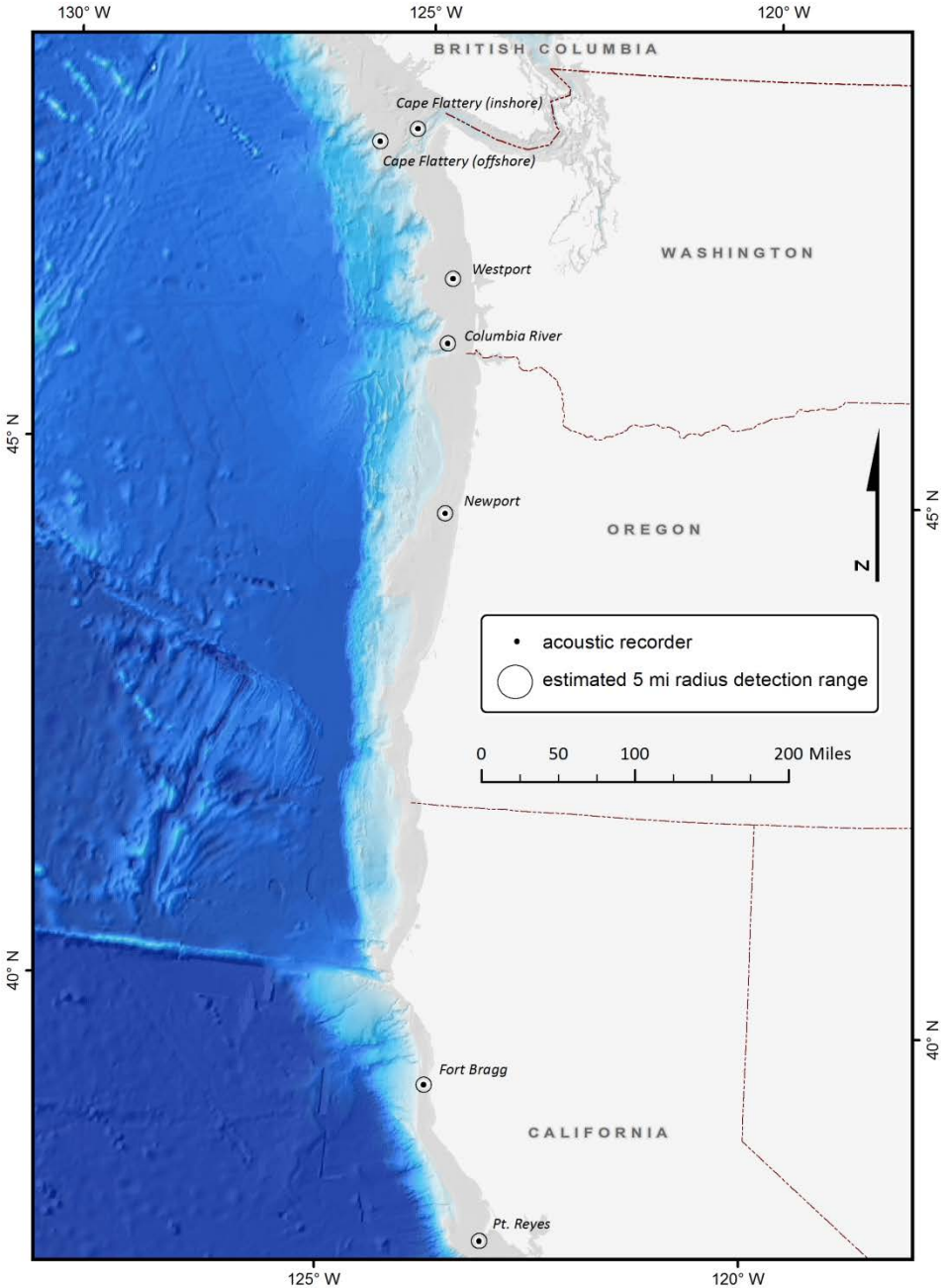


Passive Acoustic Recorders were used to assess the occurrence of Southern Resident Killer Whales off the US west coast

Recorders were deployed at up to 7 sites

Operational deployment
4 -11 months

Years deployed
2006 – 2011



Moored Passive Acoustic Recorders - PALs

Jeff Nystuen's Acoustic Rain Gauges were modified to become Passive Acoustic ListenerS (PALS)

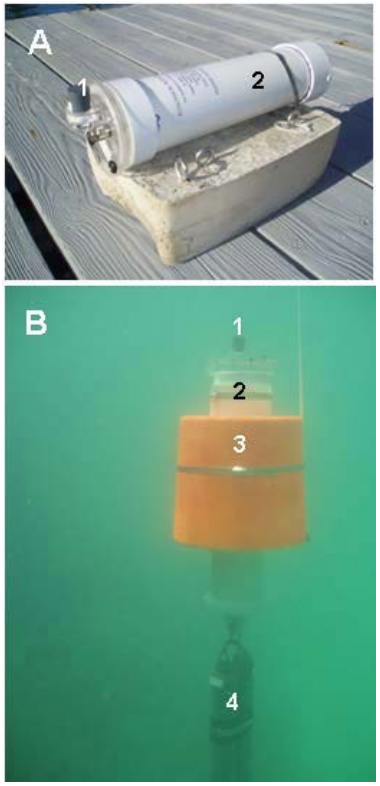
Used a decision algorithm to record "unique" sound events

Stored a 4.5 second sound clip

Daily allocation of 220 sound clips

Estimated service life - 6 months

Moored Passive Acoustic Recorders - EARs



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Marc Lammer's Ecological Acoustic Recorder (EAR)

Duty cycled to record all sounds during 30 seconds ON and then turn OFF for 300 seconds

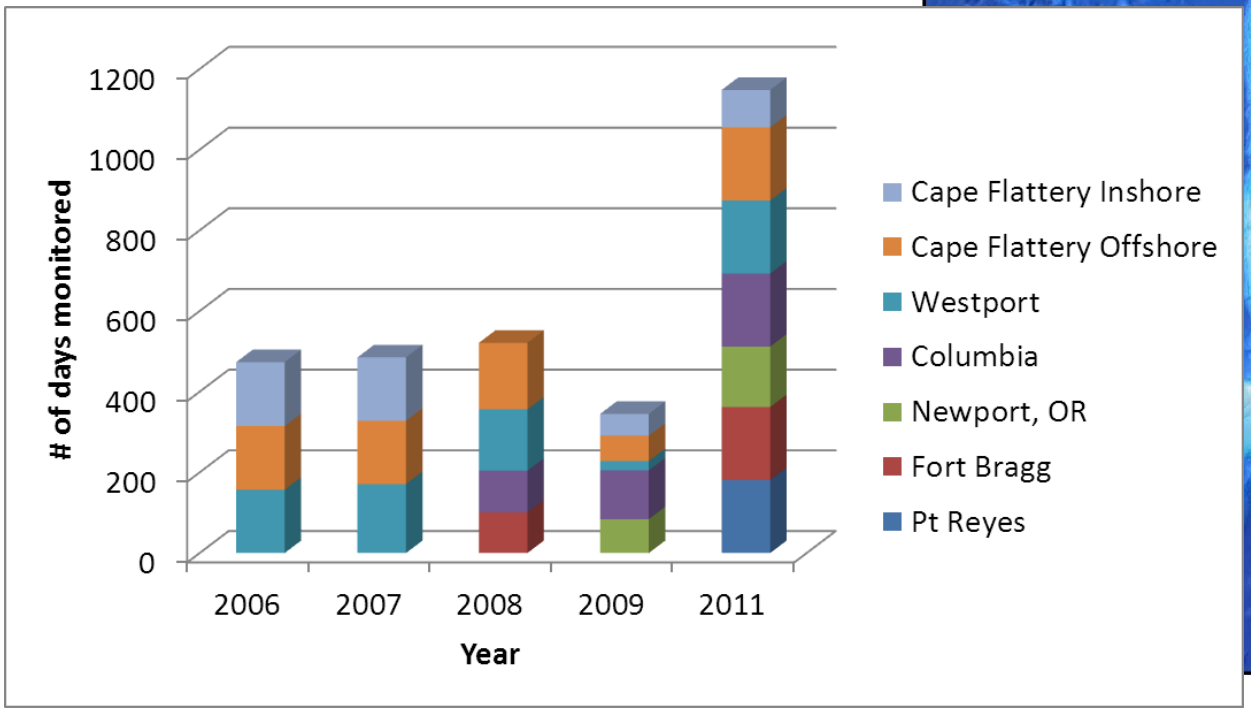
Estimated service life - 4 -11 months

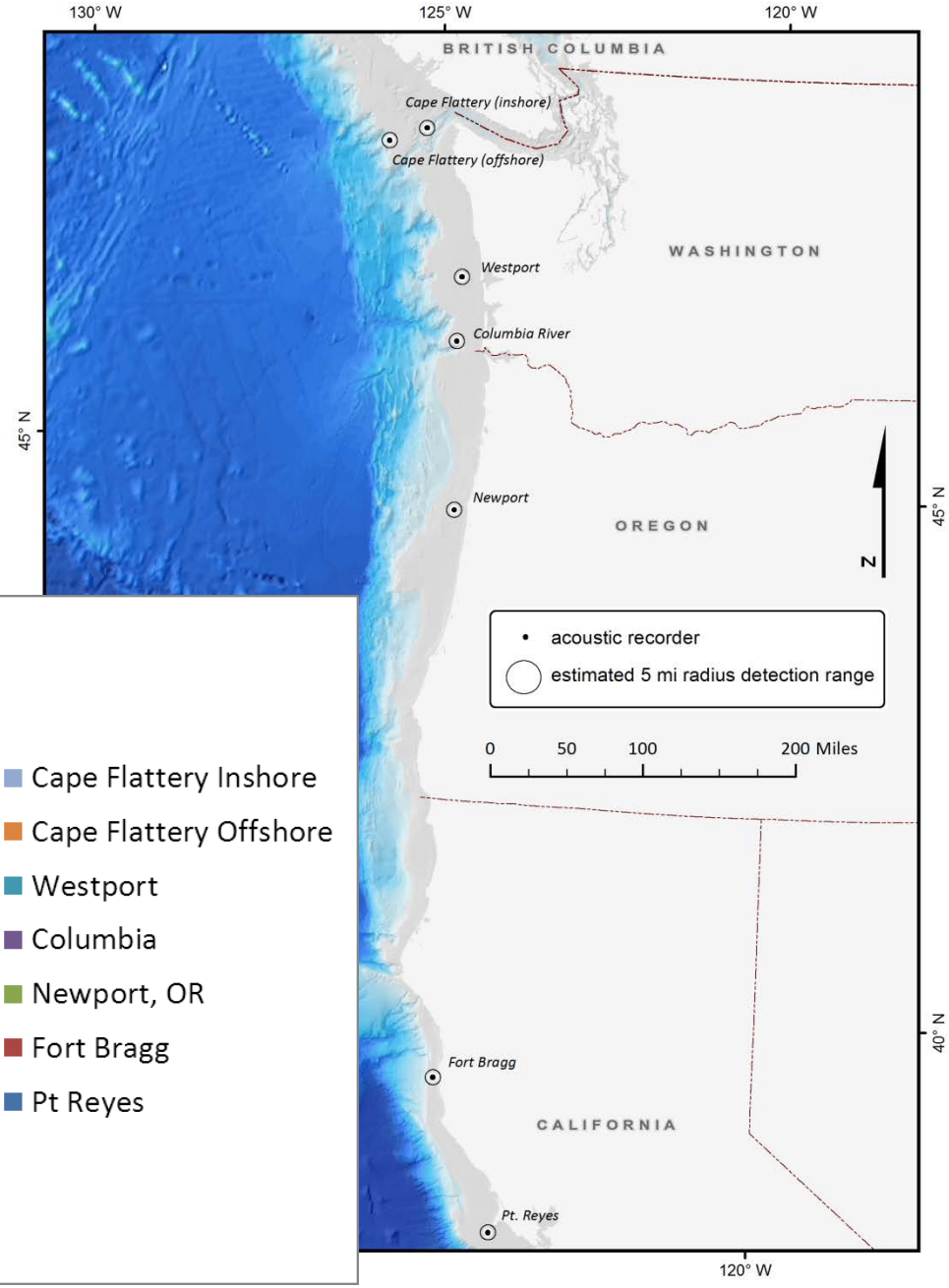
(A) A shallow EAR showing (1) the hydrophone and (2) housing attached to a concrete anchor. (B) A deep EAR showing (1) the hydrophone, (2) aluminum housing, (3) syntactic foam collar, and (4) two acoustic releases

Passive Acoustic Recorder deployment effort

Recorders were initially deployed at Cape Flattery and Westport with other sites to the south added annually

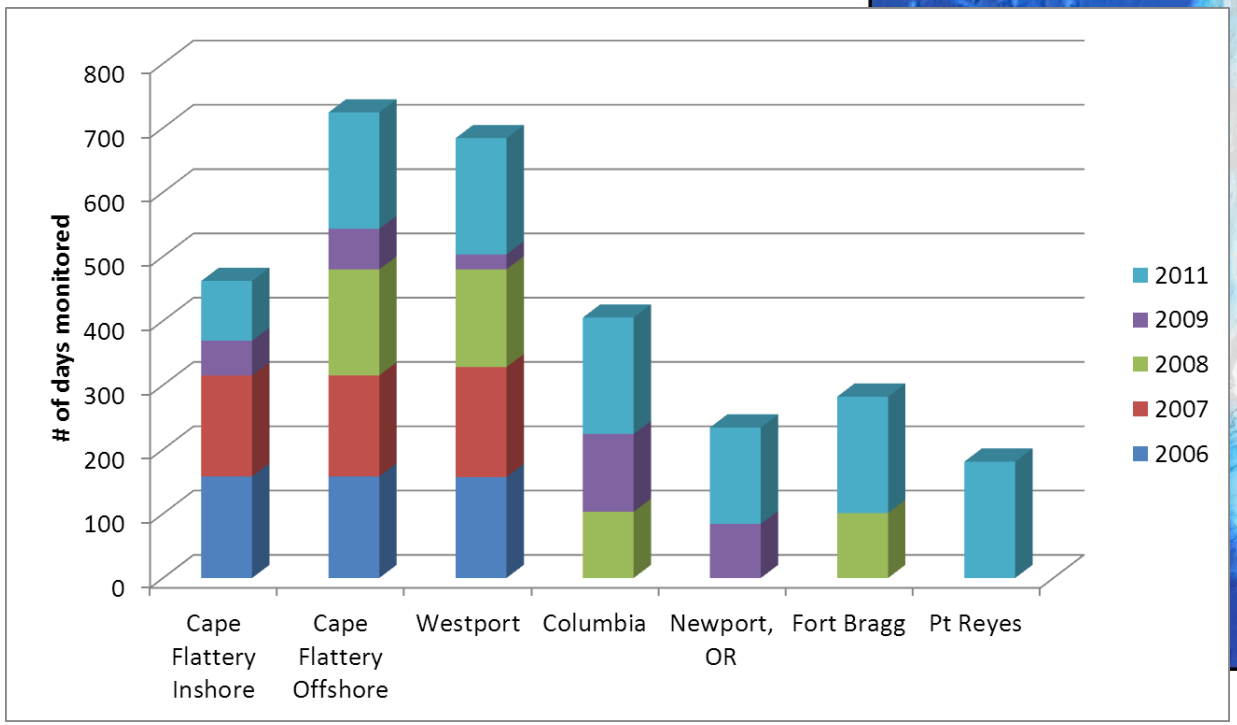
Total effort January – June n=2972 days

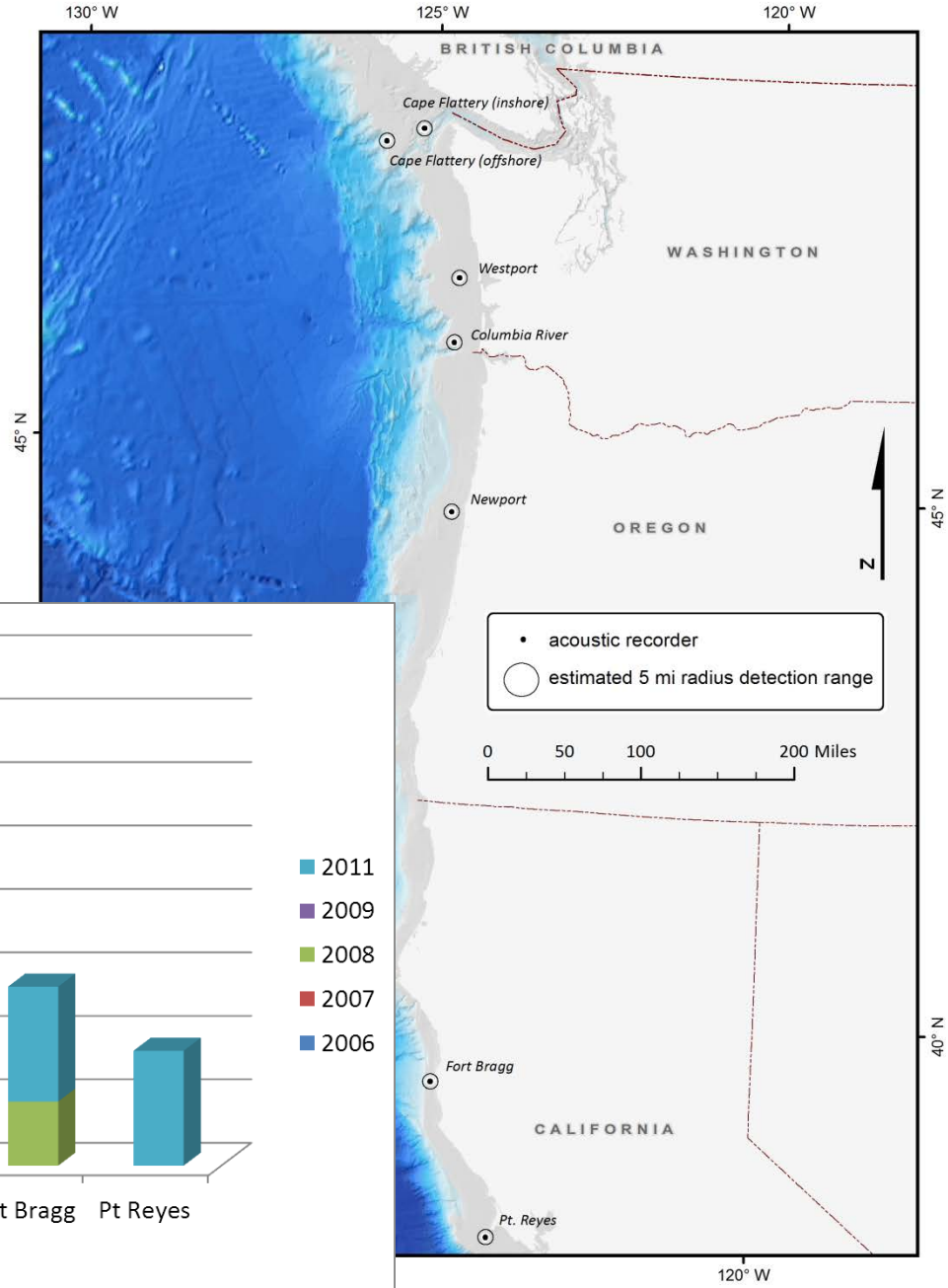




Passive Acoustic Recorder deployment effort

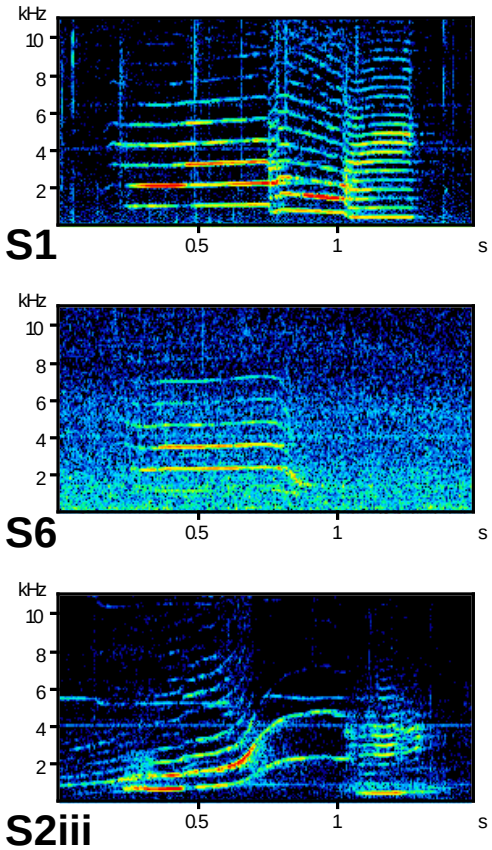
Cape Flattery Offshore and Westport had the most consistent and greatest total effort



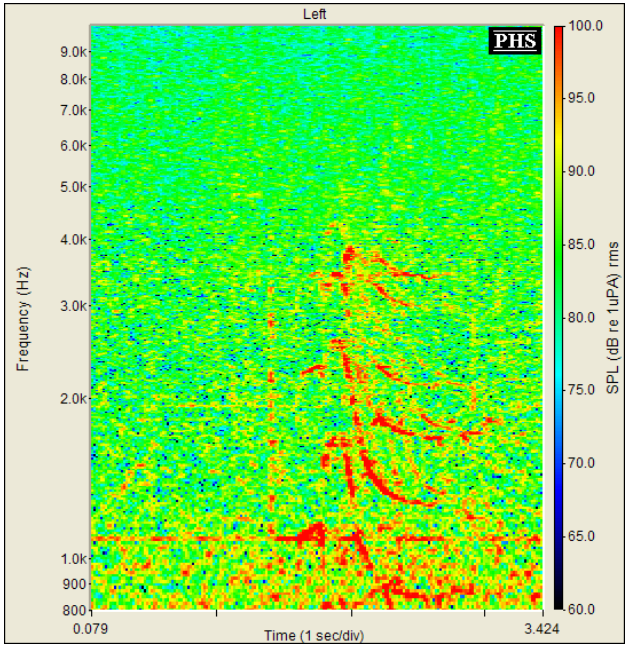


Killer whale stereotypic calls were used to classify detections to ecotype and for SRKWs to pod (J,K,L) when possible

Southern Resident calls



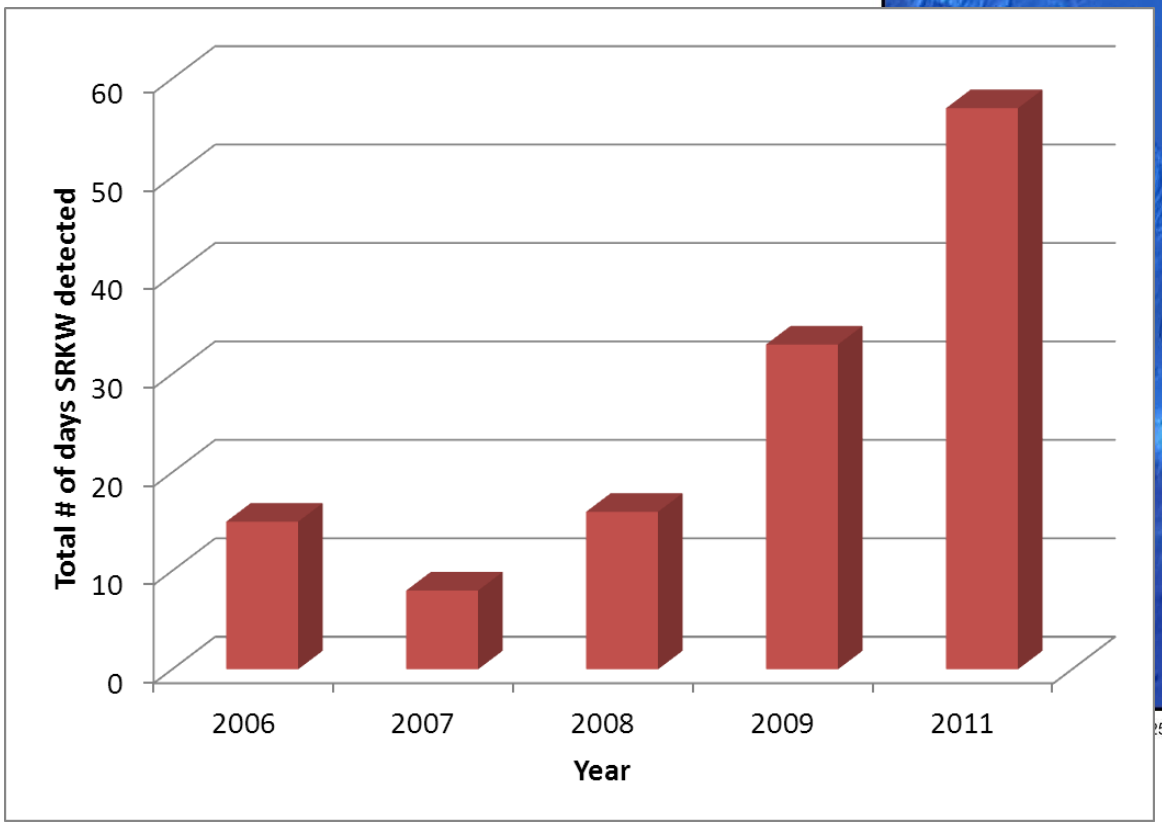
West Coast Transient call

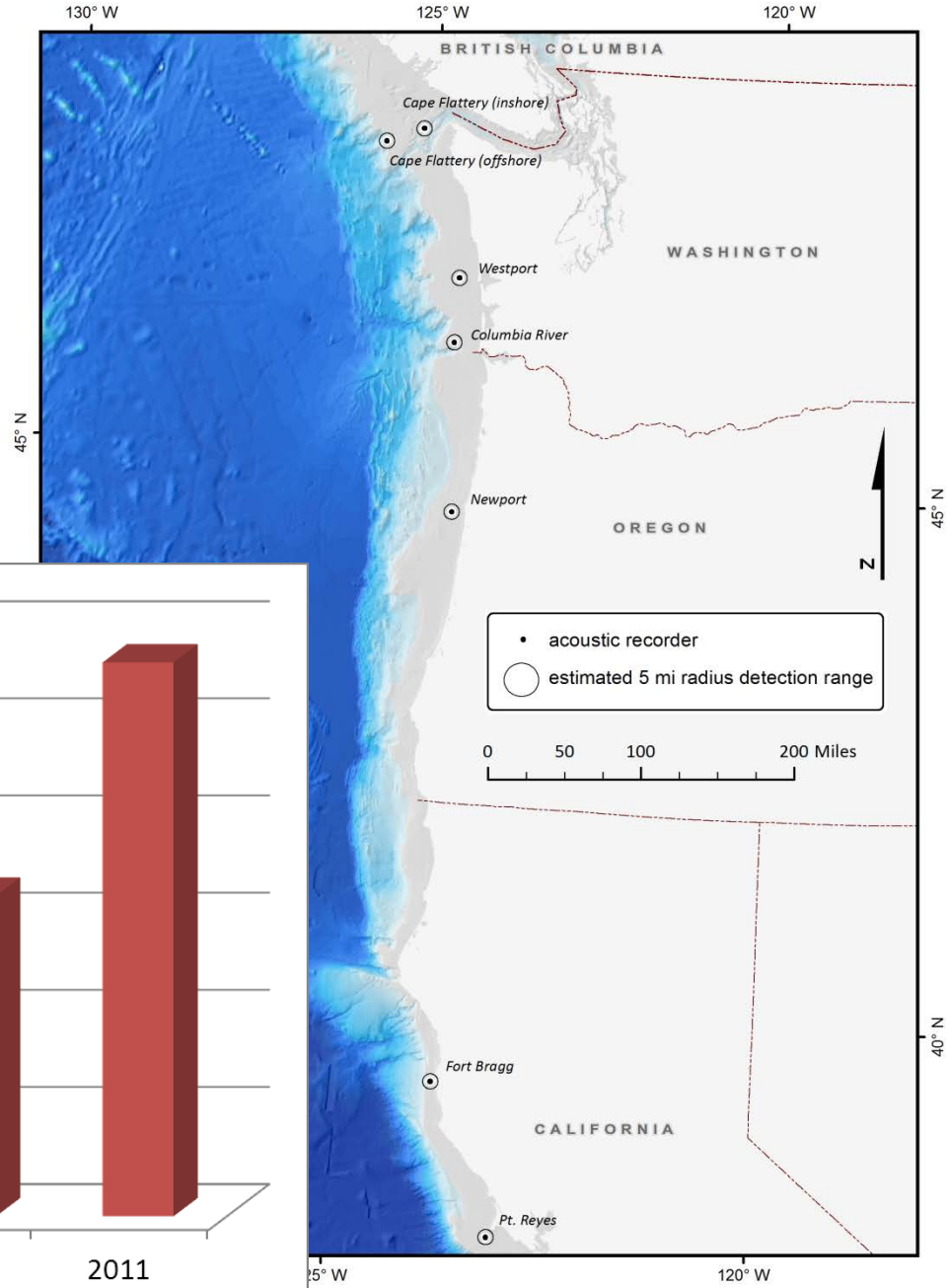


From Ford et al. 1987

Passive Acoustic Recorder deployment detections

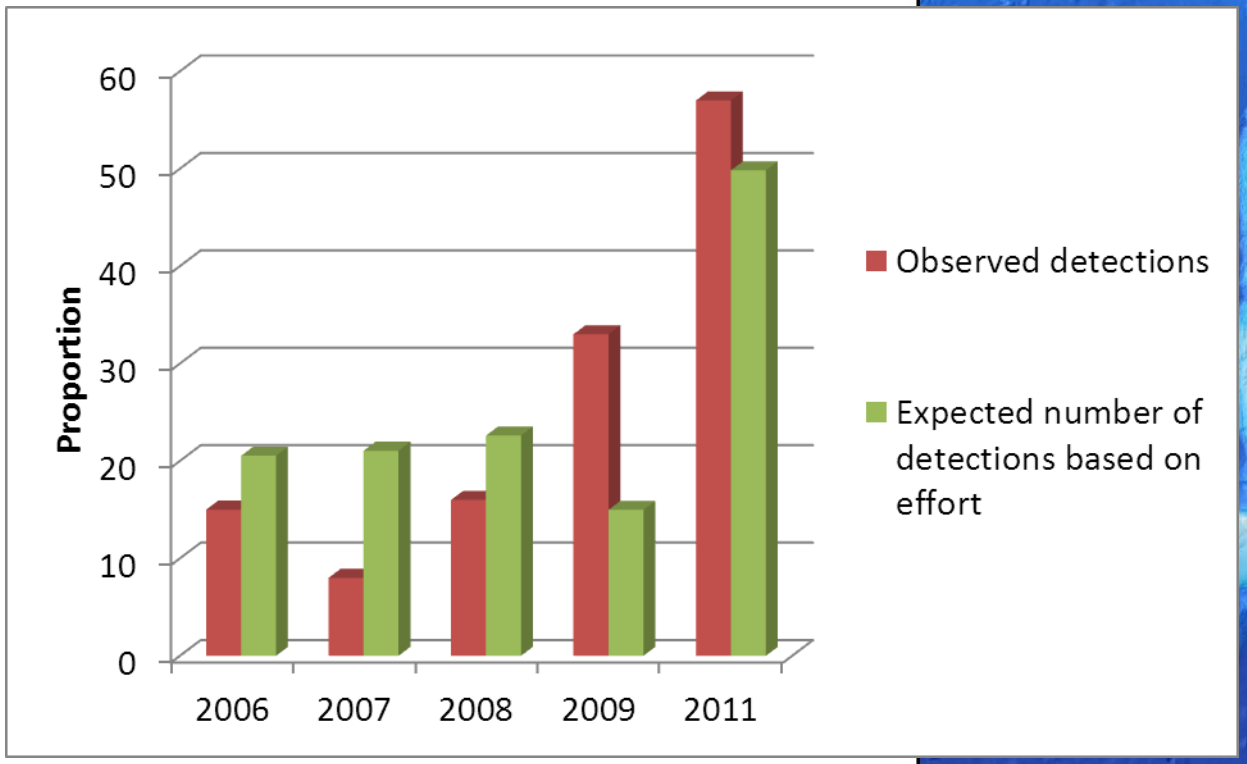
SRKWs were detected a on a total of 129 days at all recorder locations – nearly half of these occurred in 2011

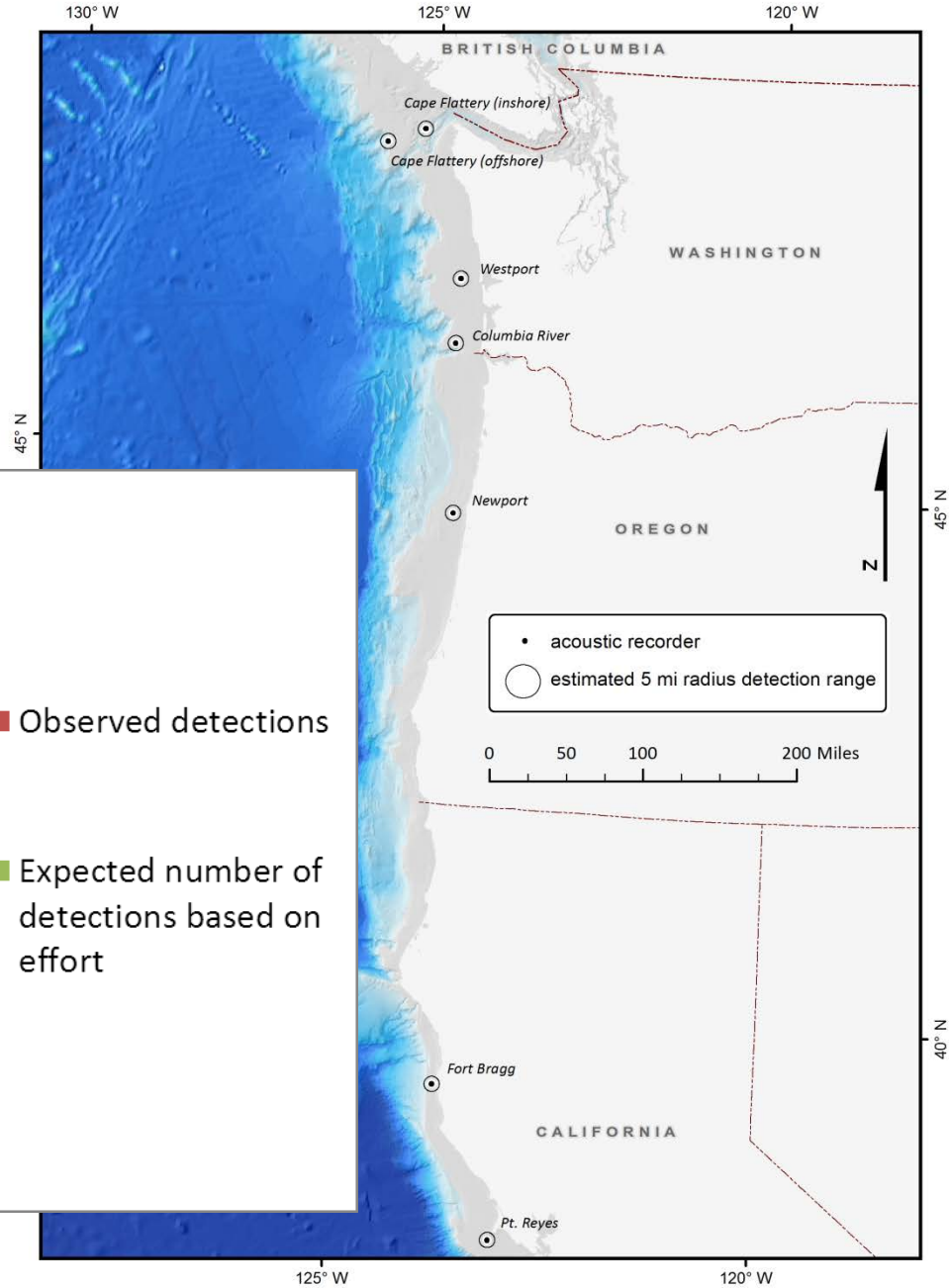




Passive Acoustic Recorder deployments

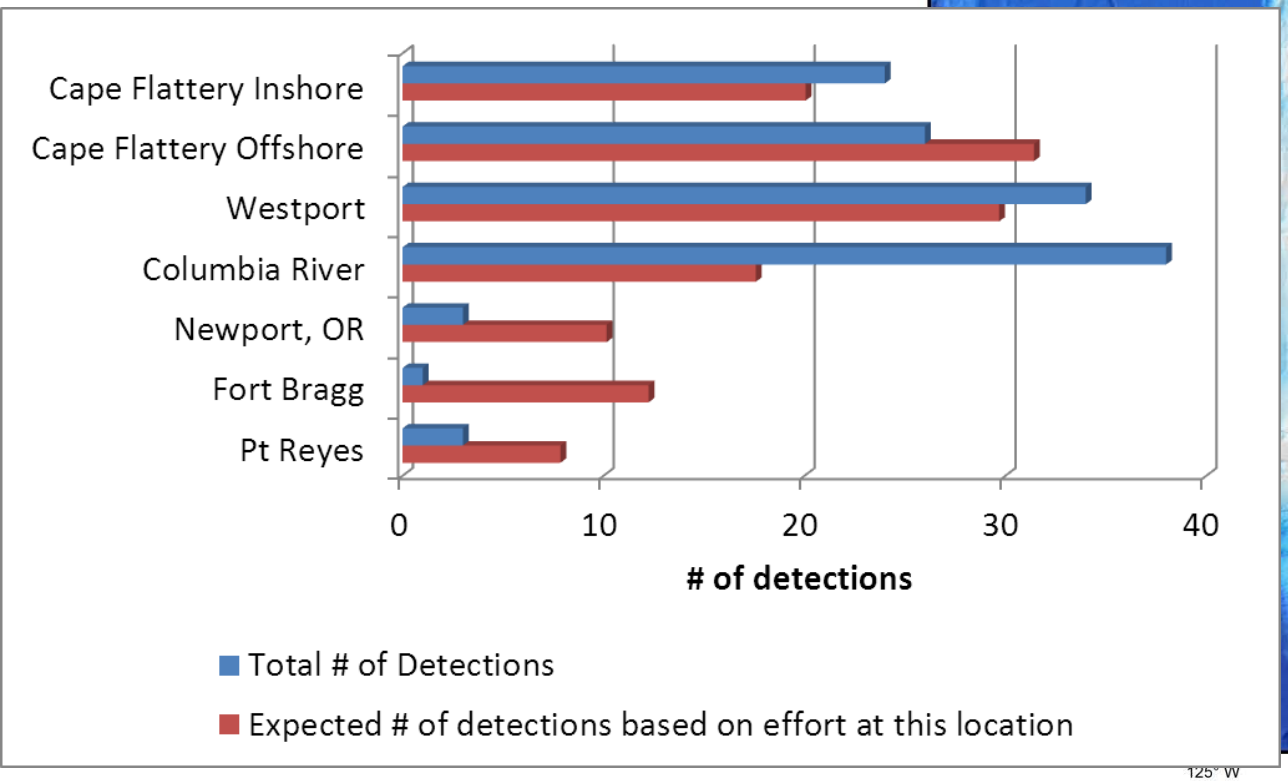
SRKWs were detected more often than expected in 2009 and 2011

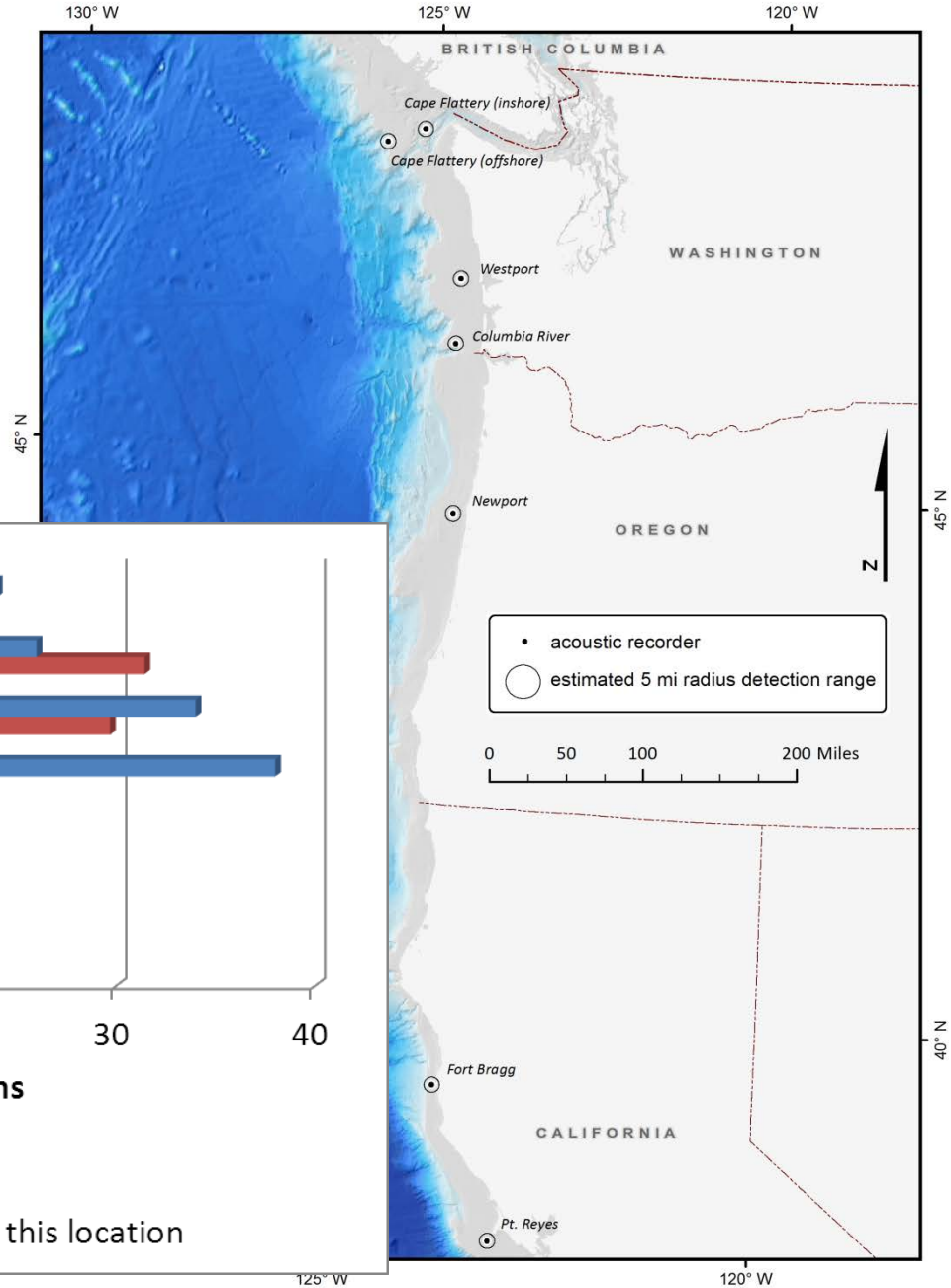




Passive Acoustic Recorder deployments

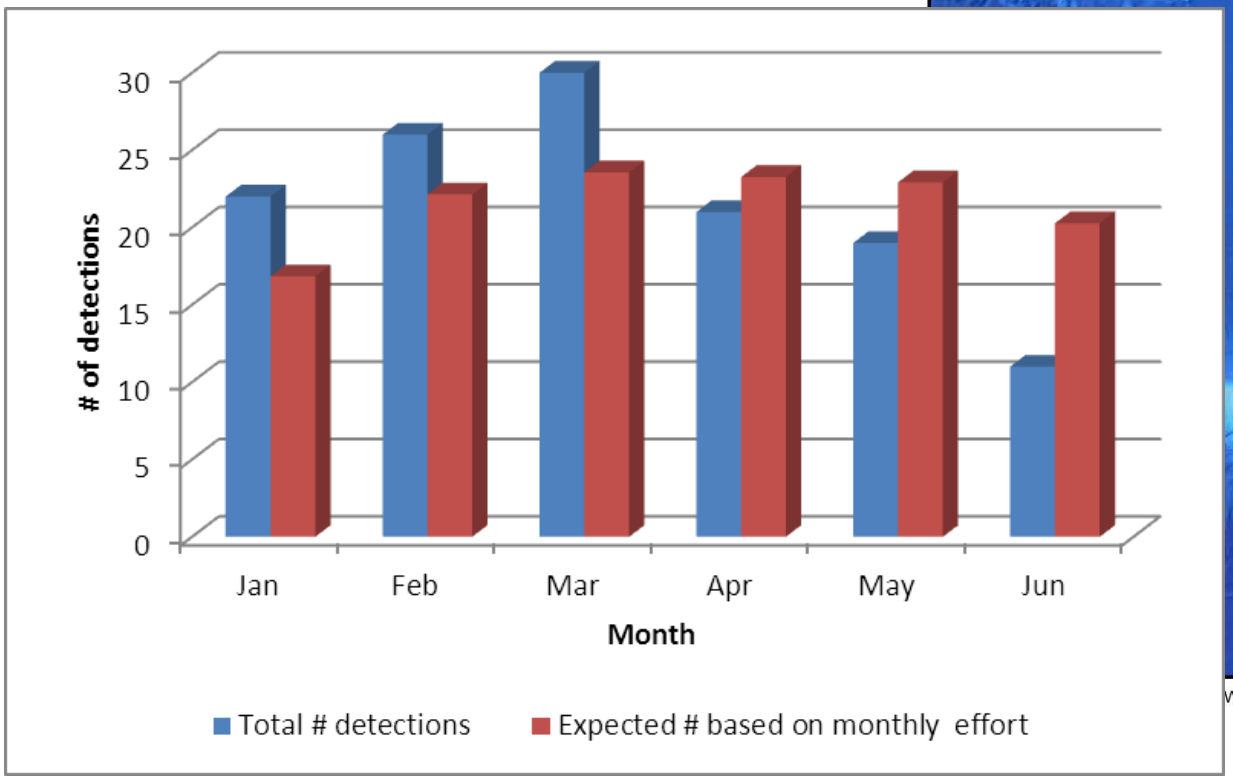
SRKWs were detected more often than expected off the Columbia River

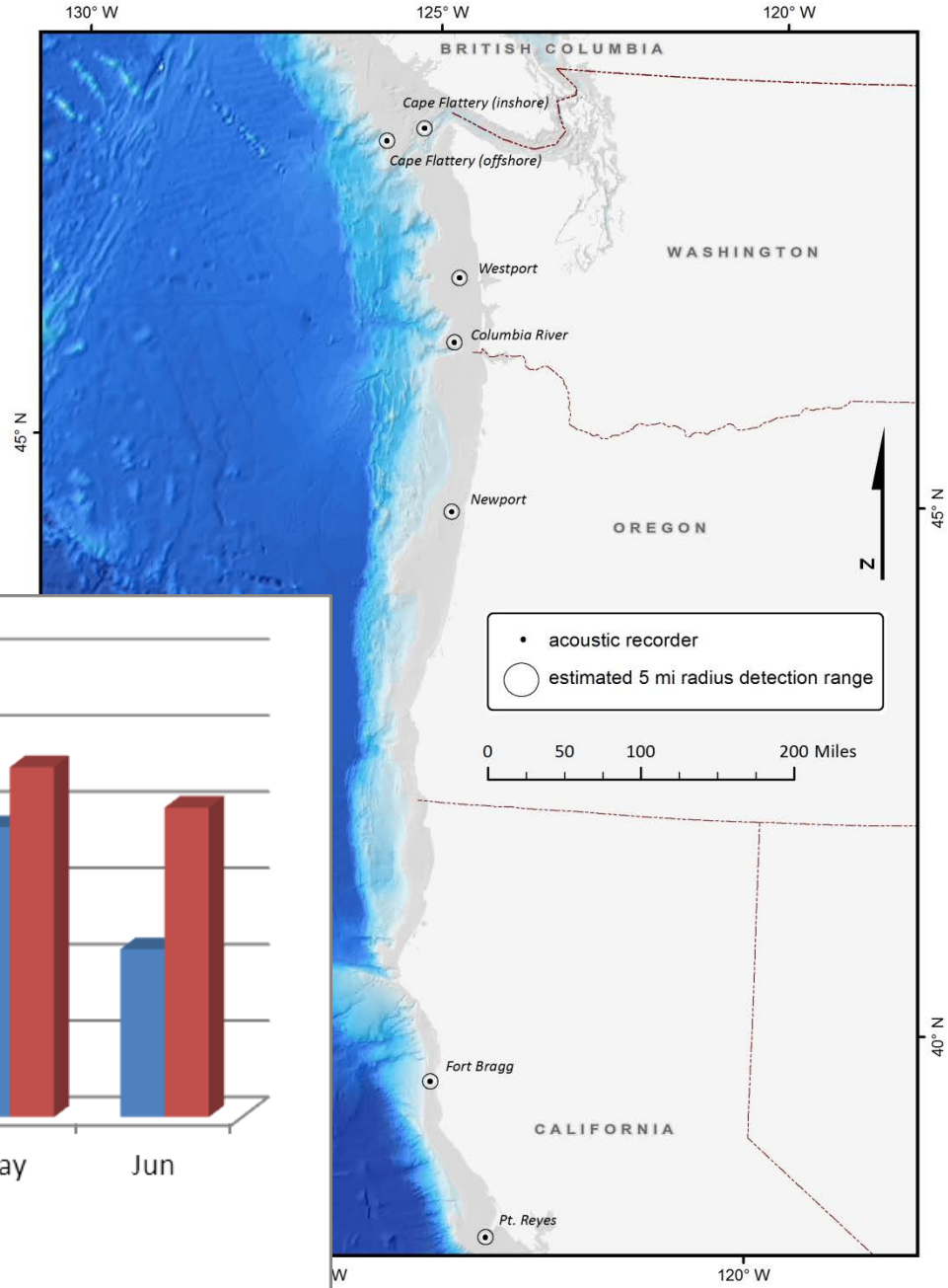




Passive Acoustic Recorder deployments

SRKWs were detected more often than expected in January, February, and March

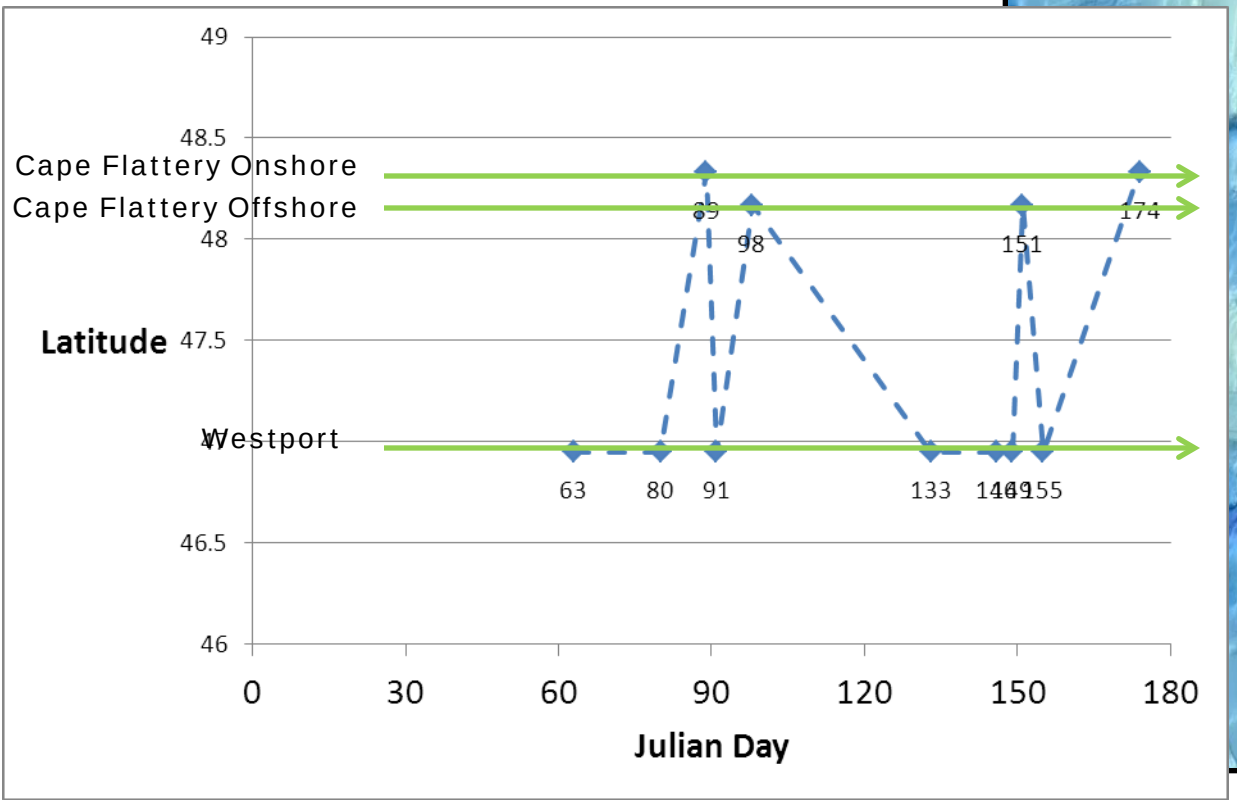


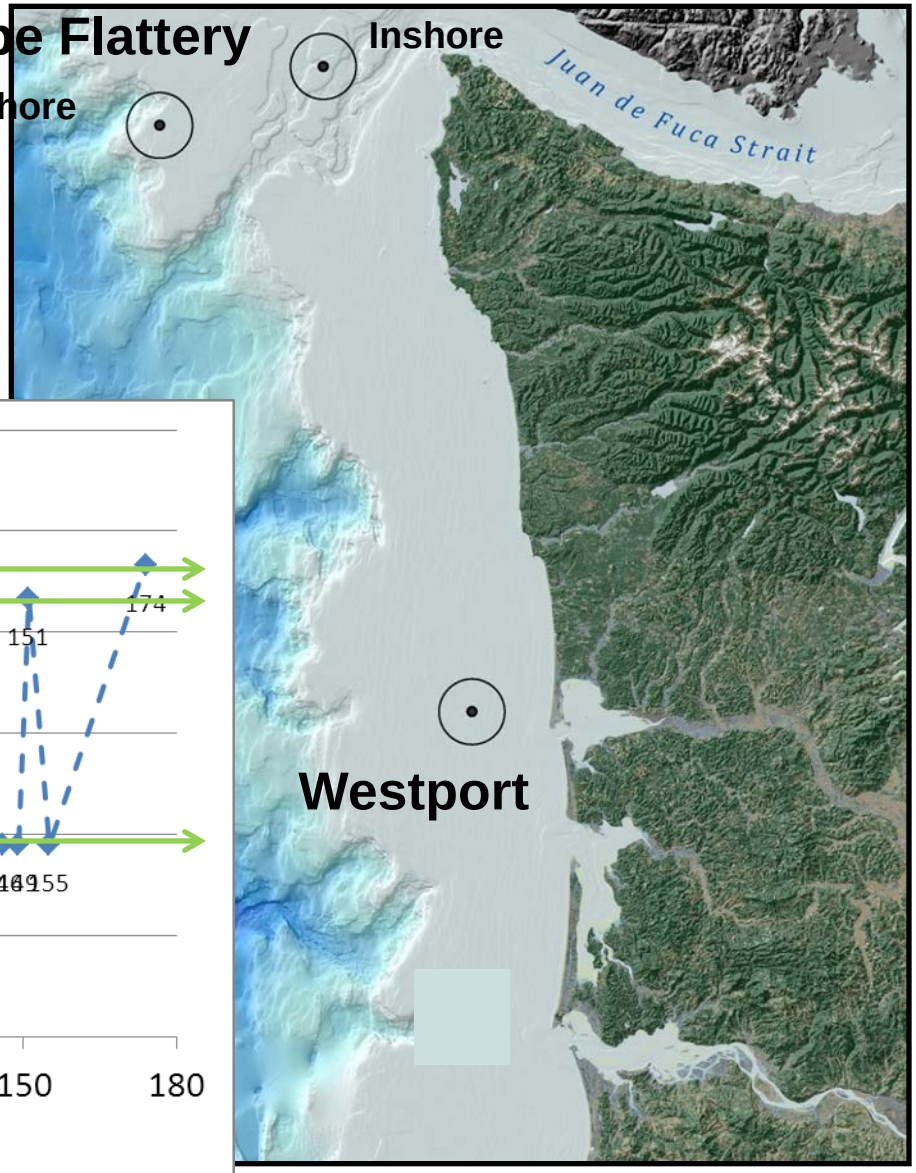


Passive Acoustic Recorder deployments

SRKWs calls (except Js) were detected on 11 days during 157 days in 2006

First detection was not until 37 days after deployment

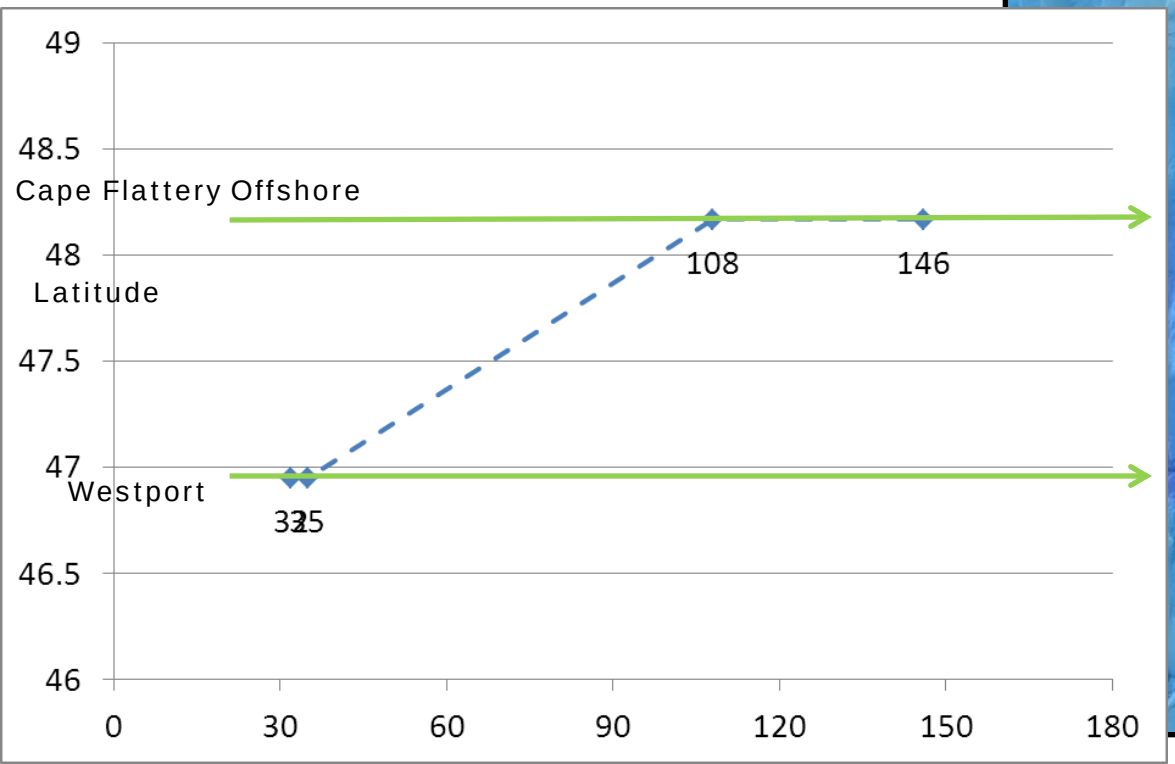


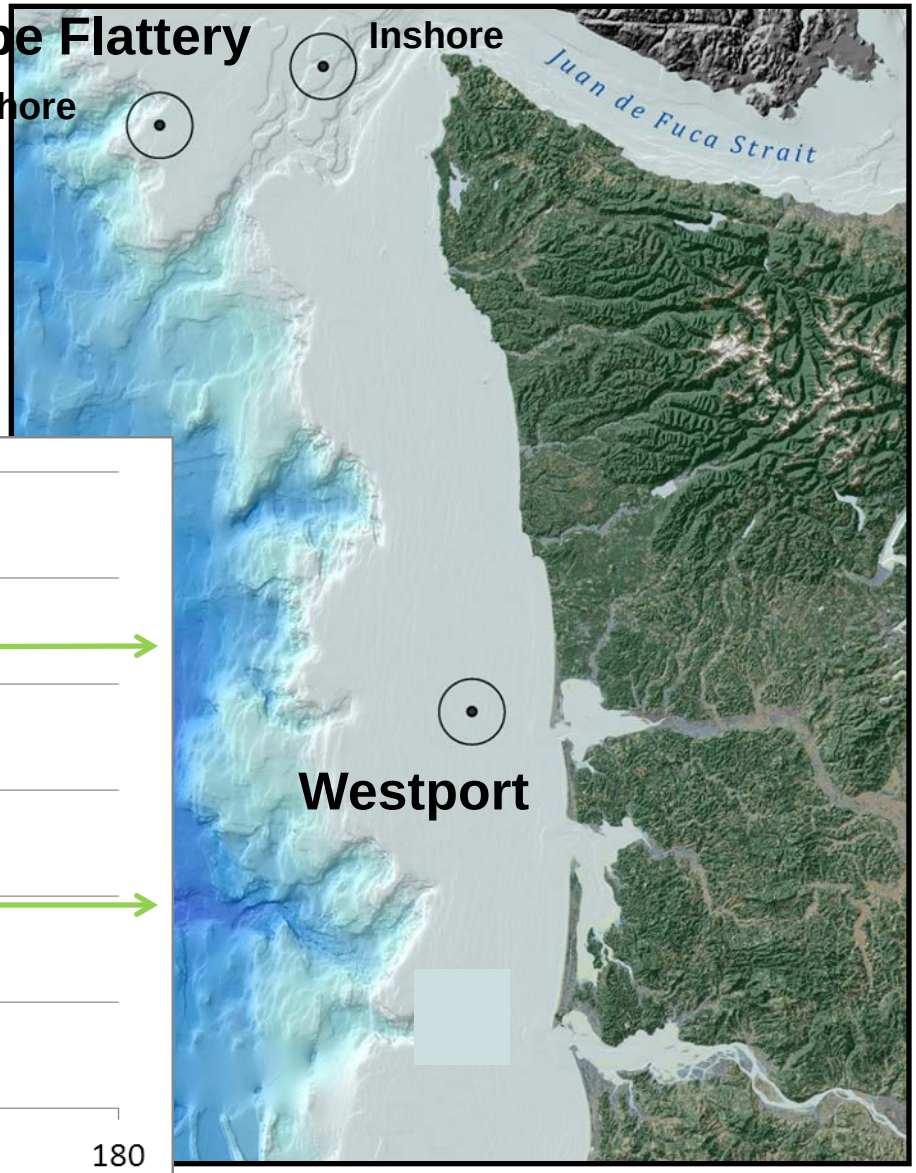


Passive Acoustic Recorder deployments

SRKWs calls (not including Js) were detected on only 4 days during 156 days in 2007

No Ls were detected, only Ks

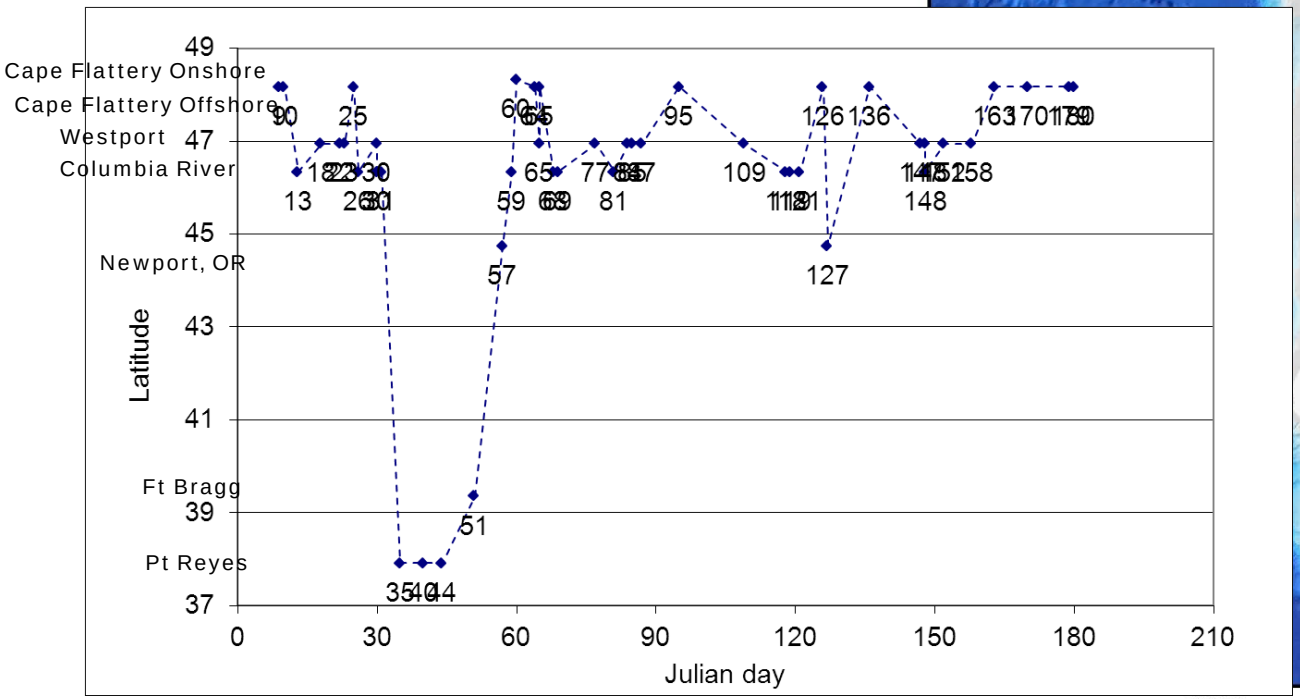


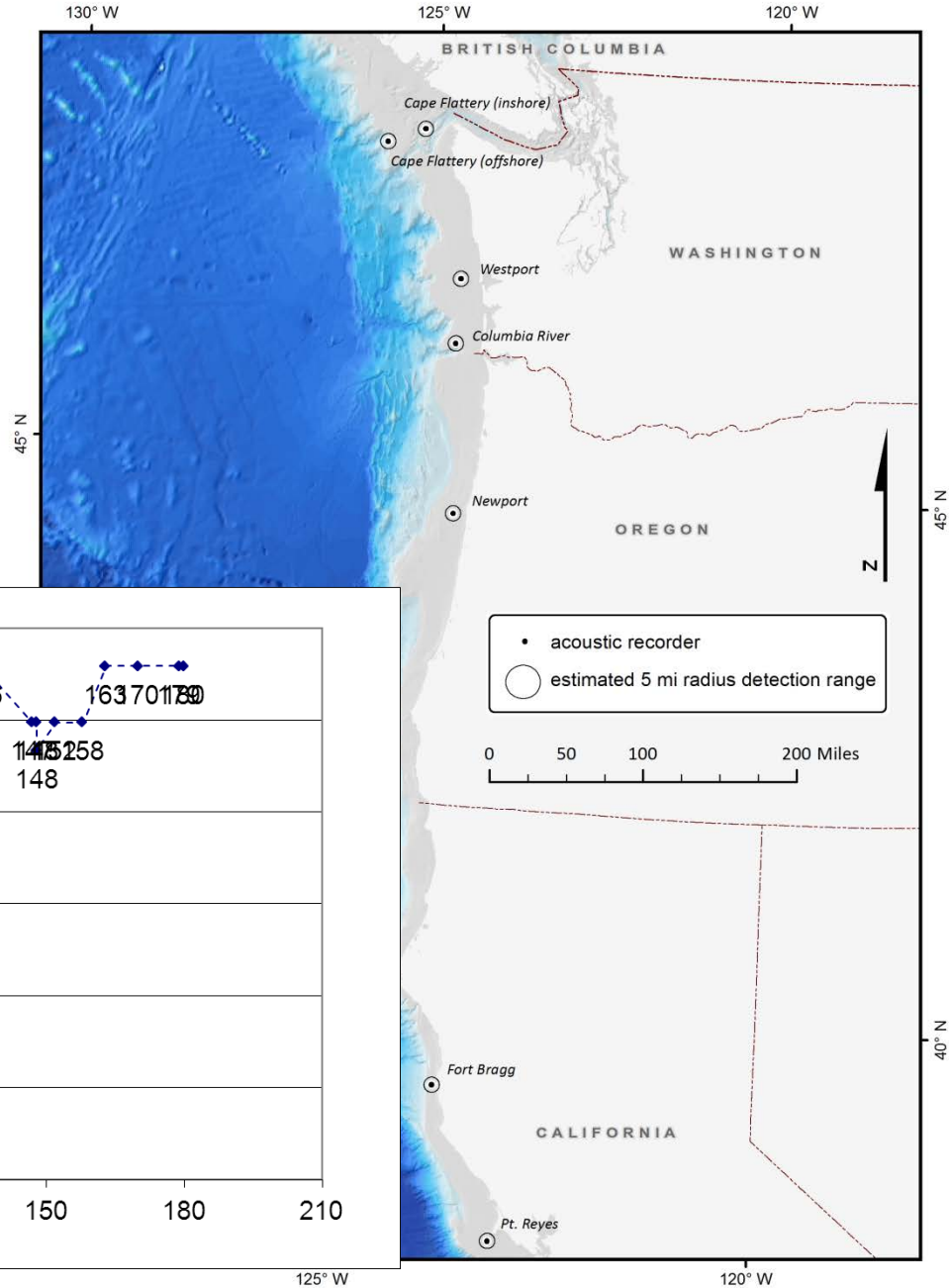


Passive Acoustic Recorder deployments

SRKWs (except Js) were detected on 57 of 180 days in 2011

There were 9 periods that exceeded a week (max 14 days) that there were no detections of SRKWs



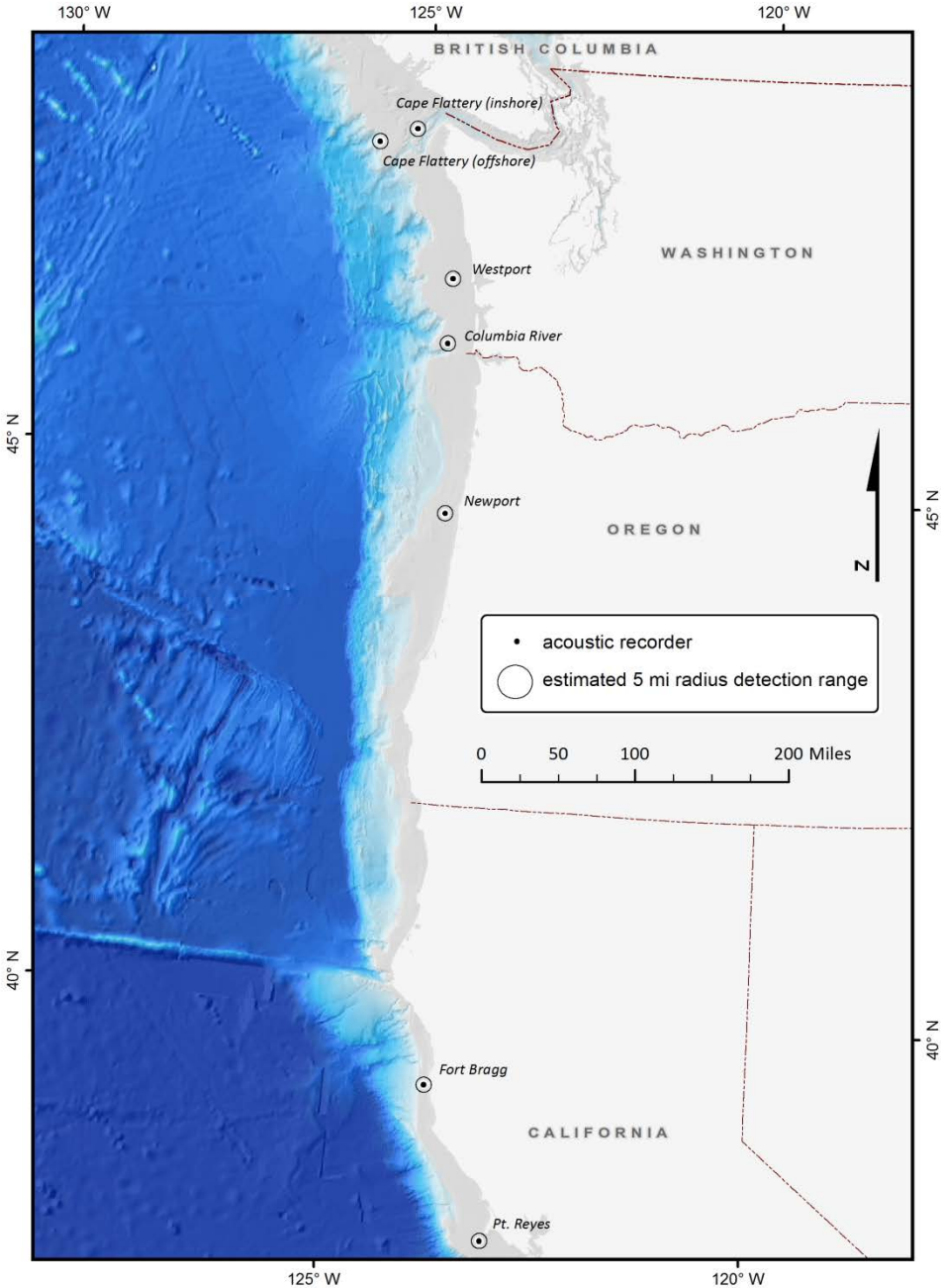


Passive Acoustic Recorder deployment effort

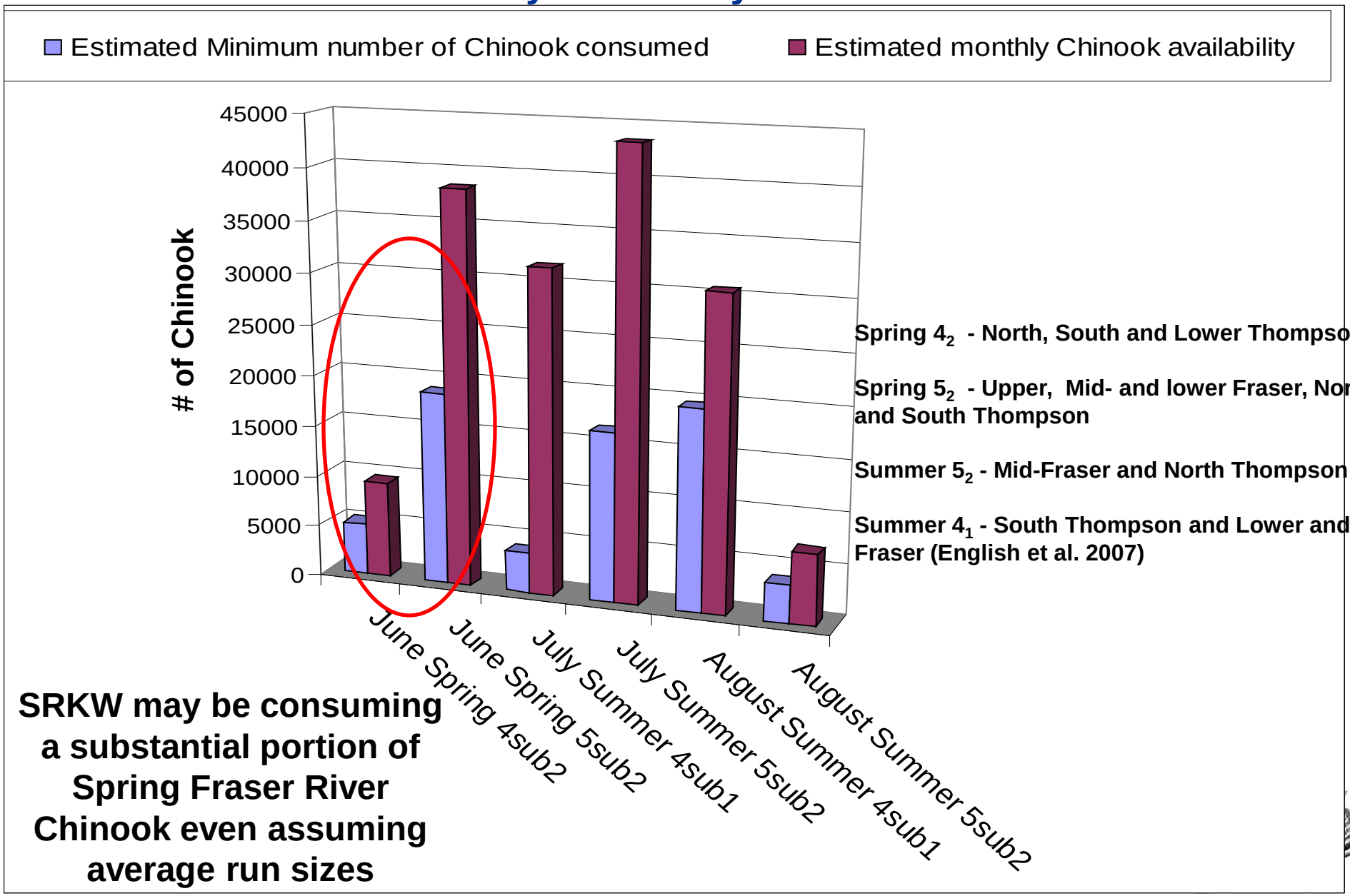
SRKWs were detected more often than expected in January, February, and March

SRKWs were detected more often than expected in 2009 and 2011 and less than expected in 2006-2008 - inter annual variability in occurrence

SRKWs were detected more often than expected off the Columbia River



Estimated monthly SRKW Chinook stock specific consumption versus estimated monthly availability of Fraser River Chinook stocks

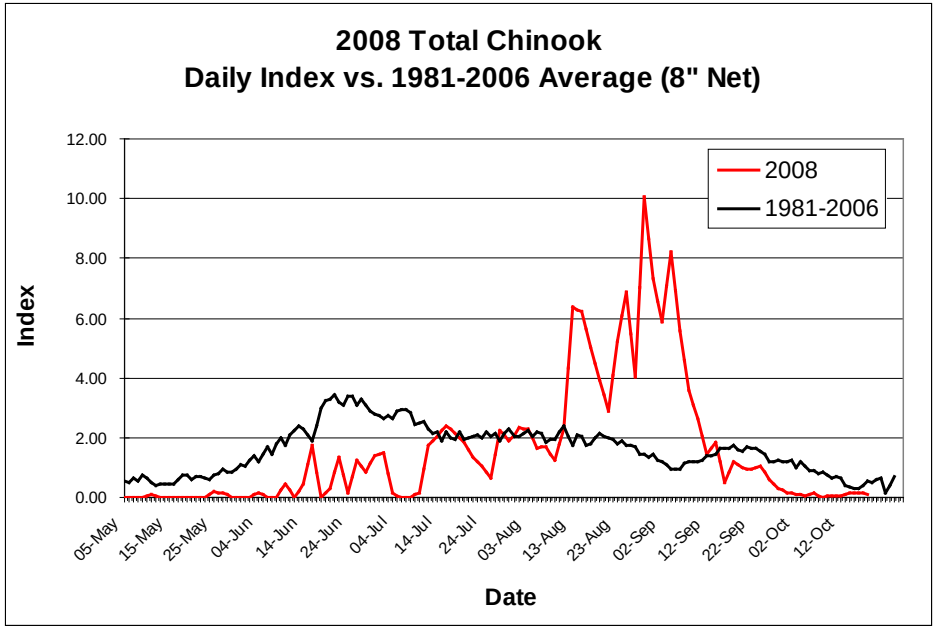


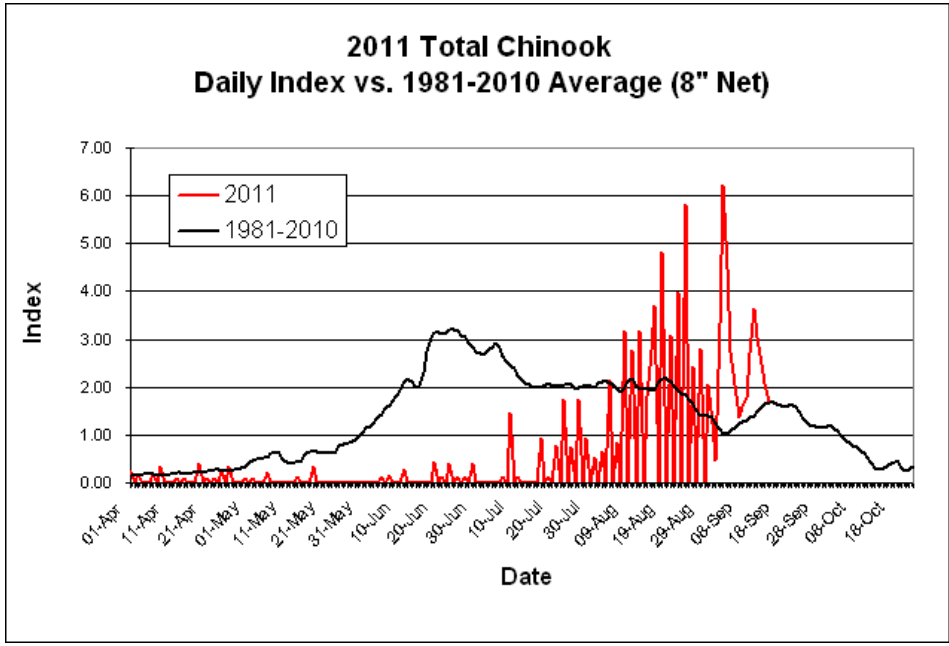
SRKW may be consuming a substantial portion of Spring Fraser River Chinook even assuming average run sizes

Returns of some stocks of Fraser River Spring and Summer Chinook began declining in 2003

"Over the past seven years, Fraser River stream-type Chinook escapements have declined, in some cases steeply, especially the 5sub2 spring and 5sub 2 summer aggregates. Combined, the escapements of those aggregates have declined from almost 92,000 in 2003 to a low of just under 23,000 in 2007. Escapement numbers improved marginally in 2010. However, they continued to be less than those of the parent generations for the 5sub2 spring aggregate and approximately at parental levels for the 4sub2 spring and 5sub2 summer aggregates. Fraser River 4sub2 spring Chinook continue to be a *stock of concern* in 2011."

"The combination of very low parental escapements combined with continuing unfavourable marine conditions may result in very low pre-fishery abundances in 2011." *Information Document to Assist Development of the Fraser Chinook Management Plan , DFO, 2011*





Albion test fishery data

Northwest Fisheries Science Center

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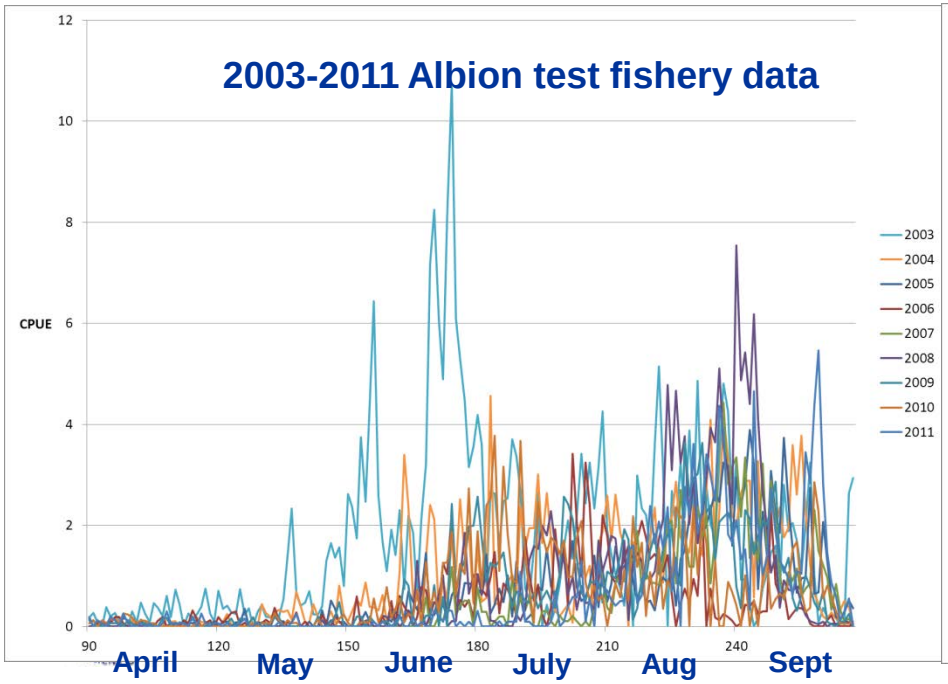
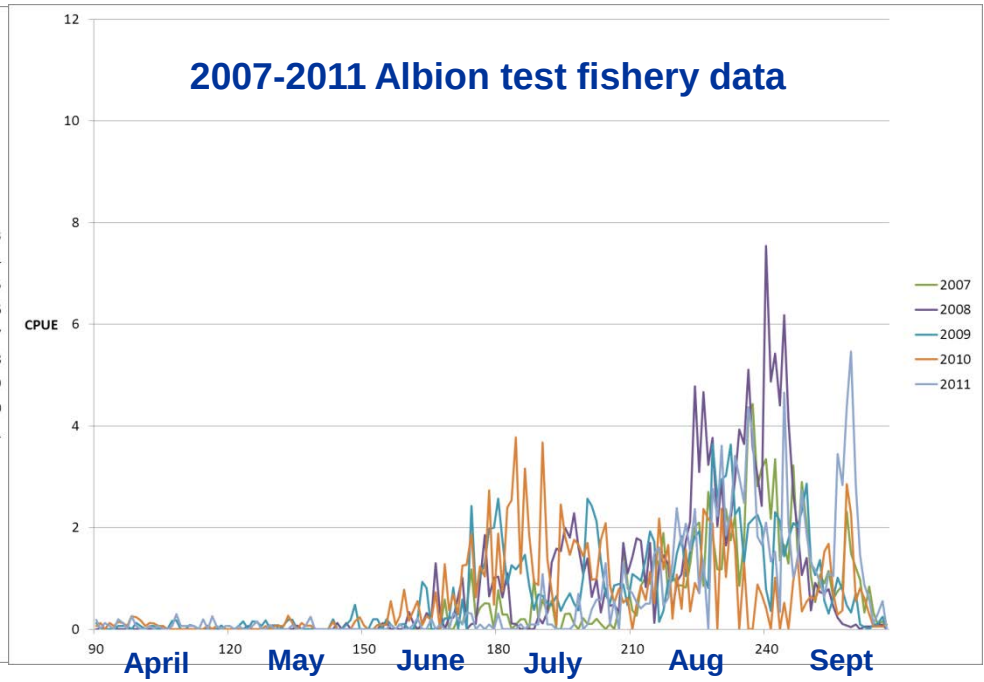
"The combination of very low parental escapements combined with continuing unfavourable marine conditions may result in very low pre-fishery abundances in 2011." *Information Document to Assist Development of the Fraser Chinook Management Plan , DFO, 2011*

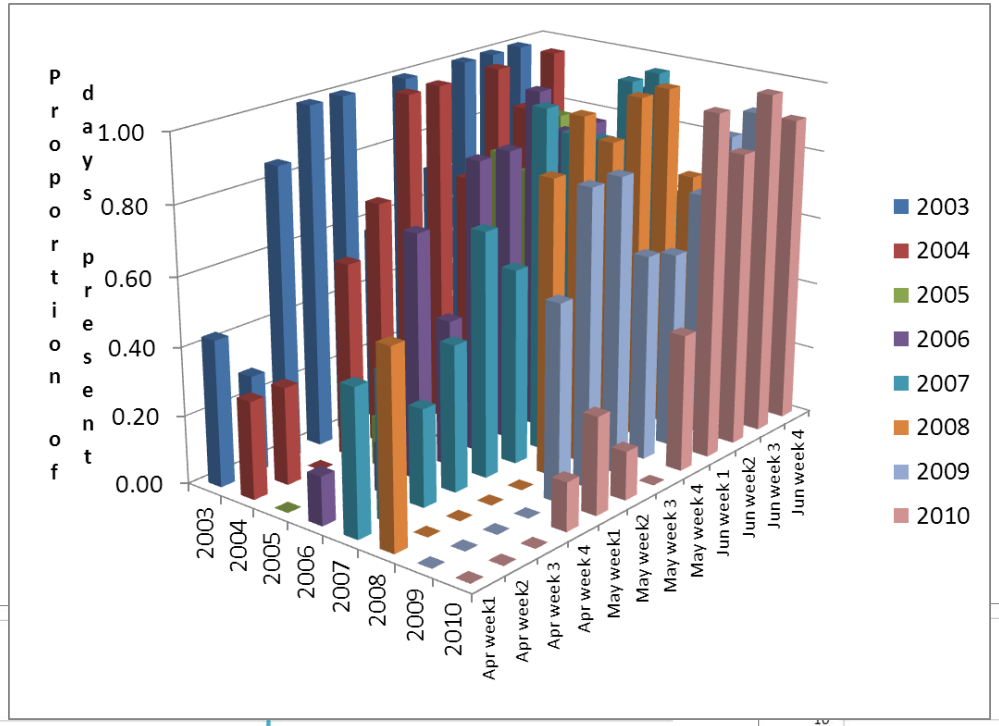
2003-2011 CPUE Albion test fishery data versus 2007-2011 CPUE Albion test fishery data

By 2007 April –June returns of Chinook are greatly reduced



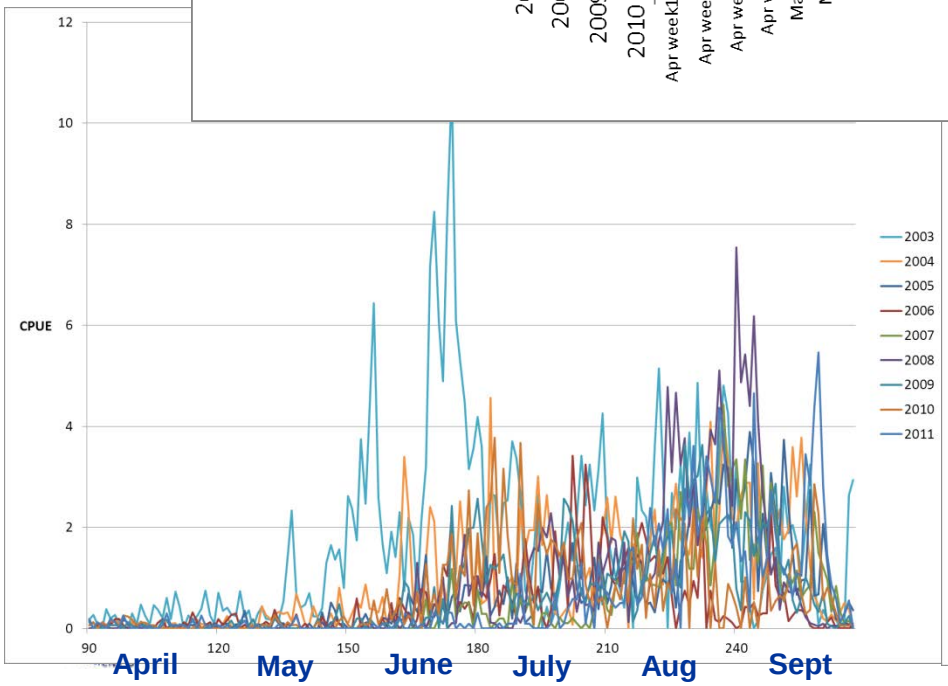


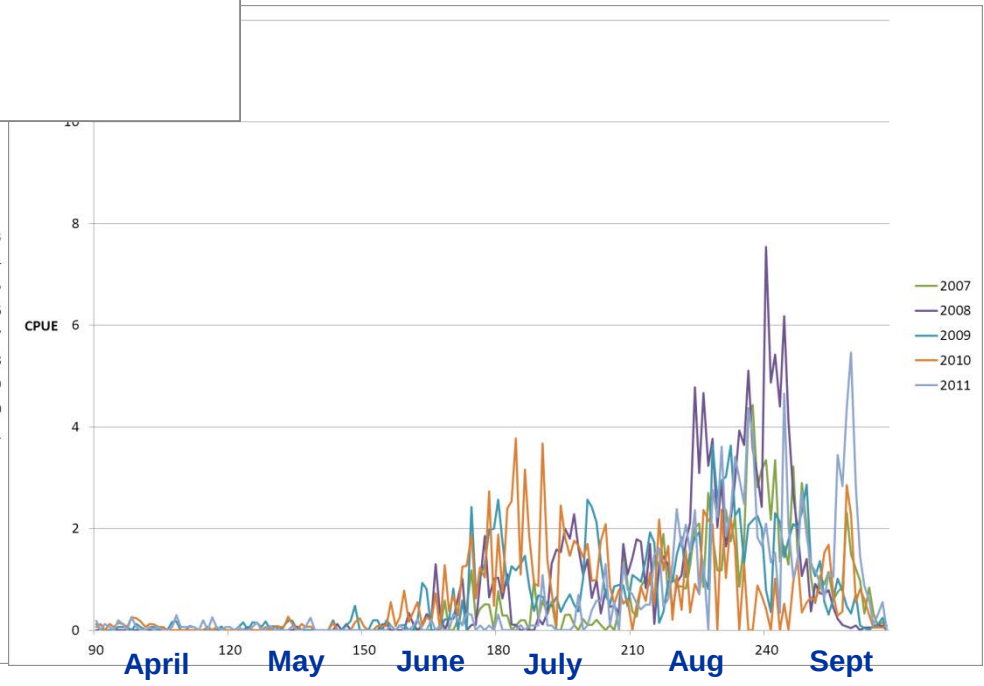
Returns of some stocks of Fraser River Spring and Summer Chinook began declining in 2003



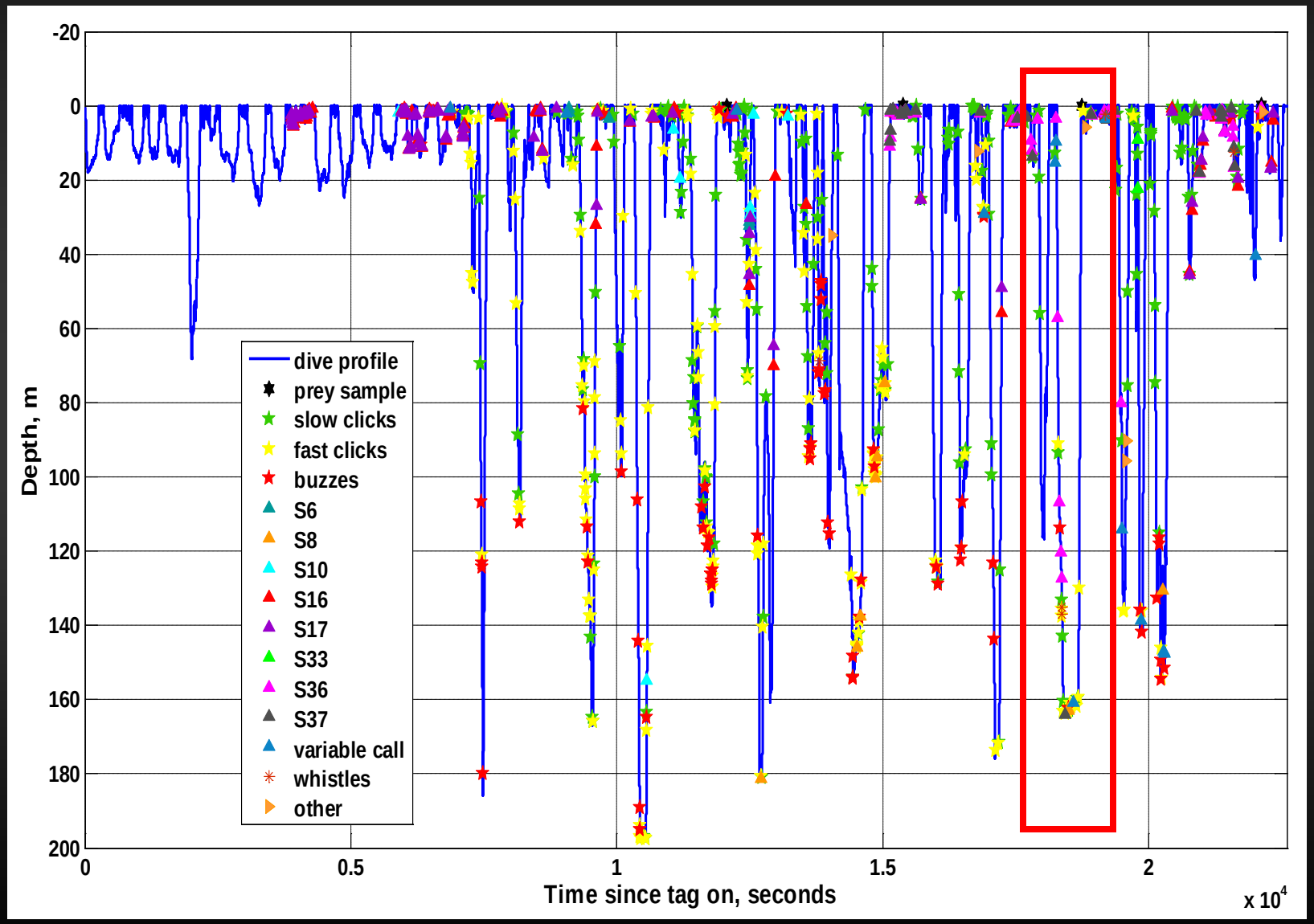
Since 2003 SRKWs:

1) Arrive in San Juans later
2) Are present a lower proportion of days
3) during 2009 and 2010 pods were subdivided or only a portion of the pod was present





Dive Profile & Vocal Behavior



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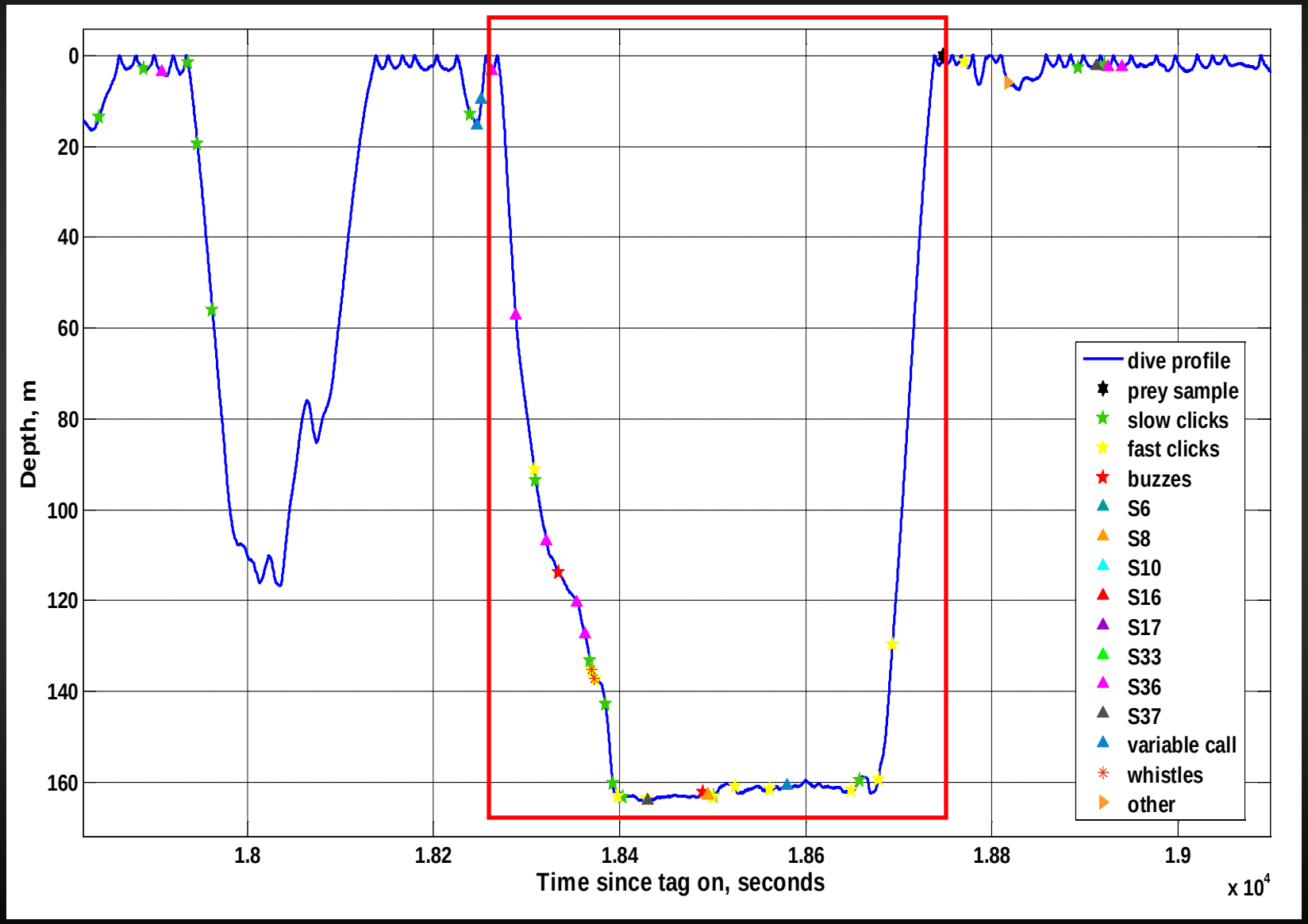
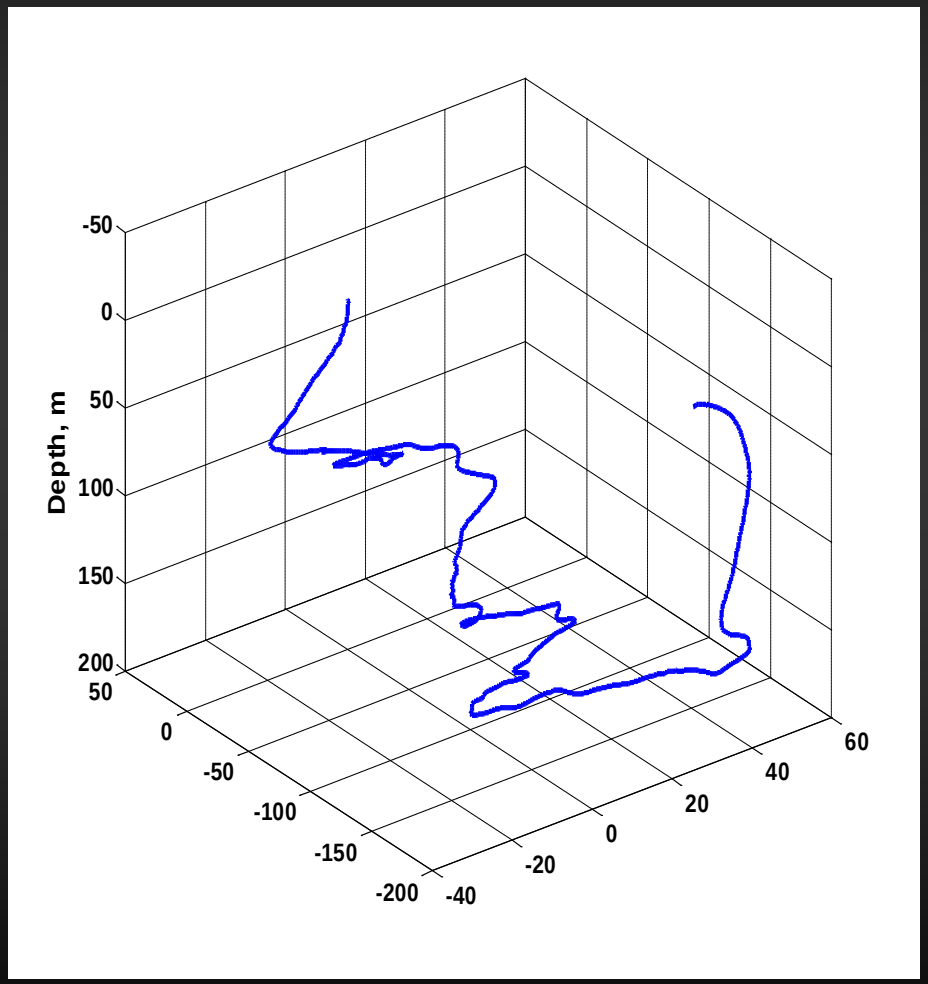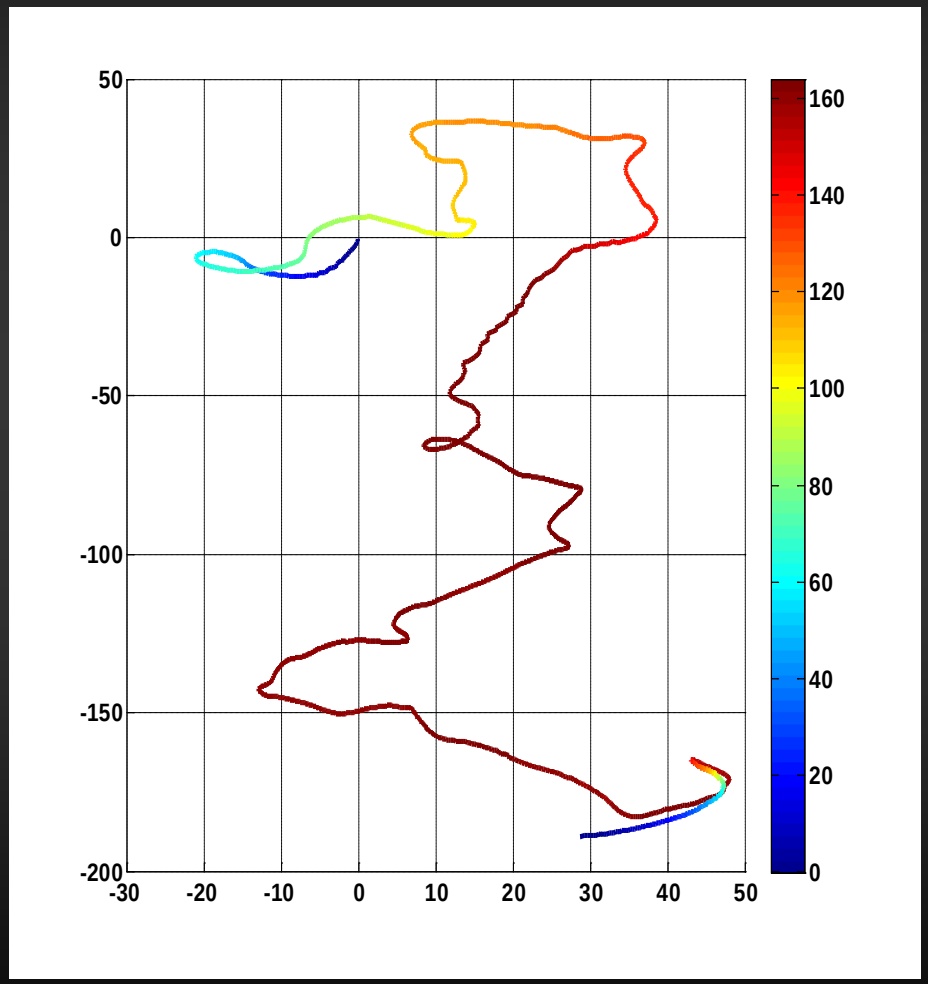
Track of Foraging Dive