Ongoing IPHC Research: Commercial sex-marking and tagging studies

Tim Loher and Ian Stewart

Photo: Rob Ames

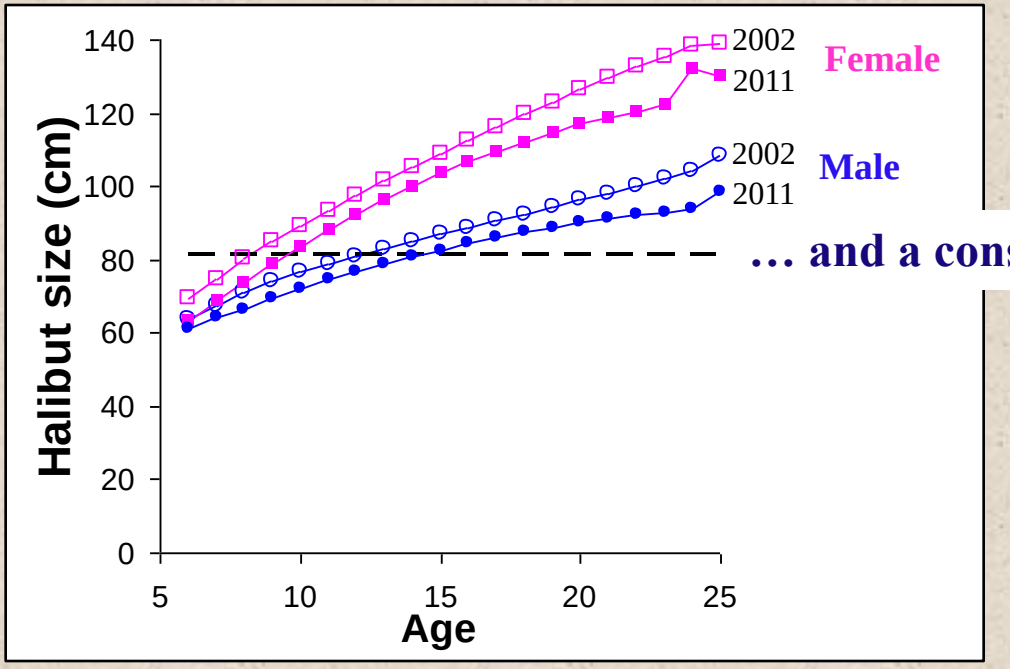
Commercial at-sea sex marking

To generate observational sex data for the assessment

Commercial at-sea sex marking

To generate observational sex data for the assessment

- **Decadal-scale decline size-at-age**



… are expected to result in increasingly female-biased catches: potentially as high as 90% female in some area(s)

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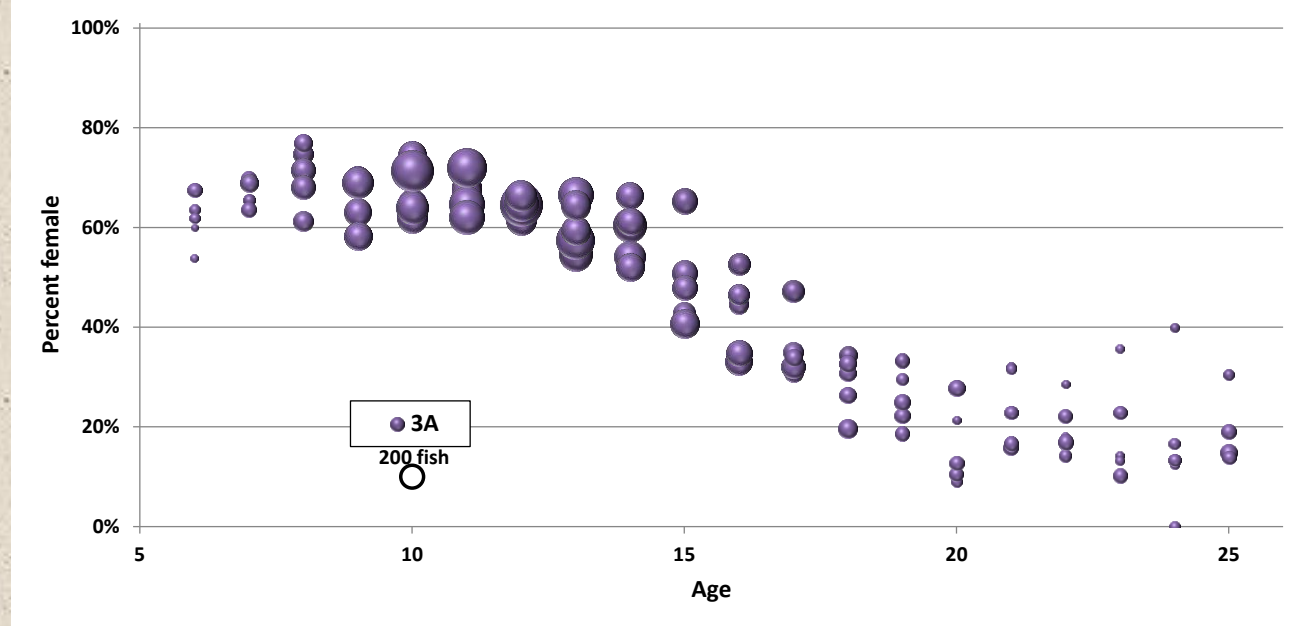
To generate observational sex data for the assessment

- **Female-biased mortality may drive age-specific changes in population sex ratio …**



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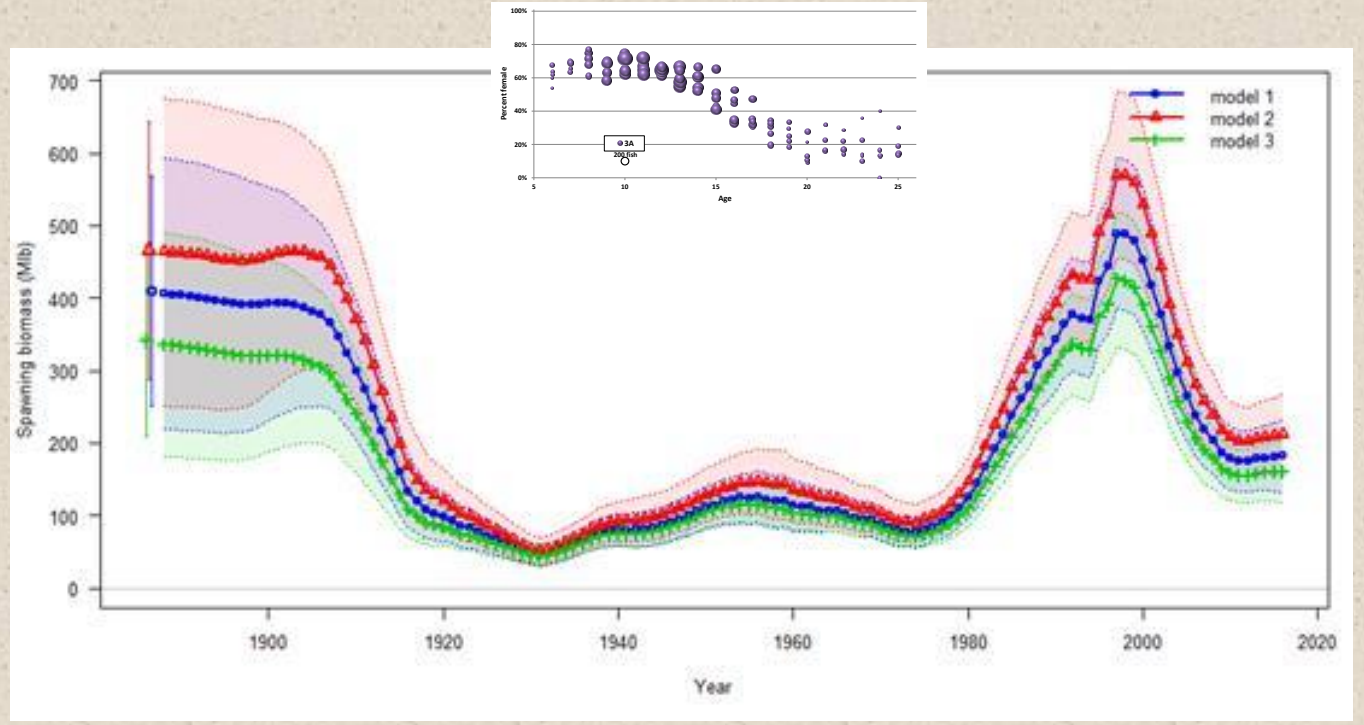

… which, in turn, affect our understanding of spawning biomass.

Commercial at-sea sex marking

We need to know the harvested sex ratios

Commercial at-sea sex marking

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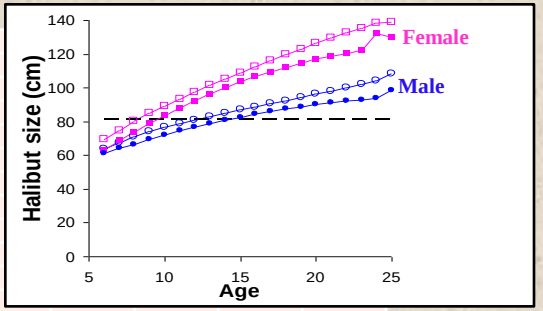
- **Bill Clark devised a statistical method based on length-age-age in our survey data …**

Meta-parameters															
	year	2010													
	area	2B													
	L50.b0	50.28713													
	L50.b1	2.776162													
	k.c0	0.034339													
	k.c1	0.020033													
	k.c2	-0.00047													
	L50.plus	112.9268													
	k.plus	0.274327													
	plus.age	25													
Proportion female at age/length															
L50		64.16794	66.9441	69.72026	72.49642	75.27258	78.04875	80.82491	83.60107	86.37723	89.15339	91.92956	94.70572	97.48188	100.258
k		0.122854	0.137761	0.151736	0.164779	0.17689	0.188069	0.198316	0.207631	0.216014	0.223465	0.229984	0.235571	0.240226	0.243949
		5	6	7	8	9	10	11	12	13	14	15	16	17	18
	82	0.899	0.888	0.866	0.827	0.767	0.678	0.558	0.418	0.280	0.168	0.092	0.048	0.024	0.011
	83	0.910	0.901	0.882	0.850	0.797	0.717	0.606	0.469	0.325	0.202	0.114	0.060	0.030	0.015
	84	0.920	0.913	0.897	0.869	0.824	0.754	0.652	0.521	0.374	0.240	0.139	0.074	0.038	0.019
	85	0.928	0.923	0.910	0.887	0.848	0.787	0.696	0.572	0.426	0.283	0.169	0.092	0.047	0.024
	86	0.936	0.932	0.922	0.902	0.870	0.817	0.736	0.622	0.480	0.331	0.204	0.114	0.060	0.030
	87	0.943	0.941	0.932	0.916	0.888	0.843	0.773	0.669	0.534	0.382	0.243	0.140	0.075	0.038
	88	0.949	0.948	0.941	0.928	0.905	0.867	0.806	0.714	0.587	0.436	0.288	0.171	0.093	0.048
	89	0.955	0.954	0.949	0.938	0.919	0.887	0.835	0.754	0.638	0.491	0.338	0.207	0.115	0.060
	90	0.960	0.960	0.956	0.947	0.931	0.904	0.861	0.791	0.686	0.547	0.391	0.248	0.142	0.076
	91	0.964	0.965	0.962	0.955	0.942	0.920	0.883	0.823	0.731	0.602	0.447	0.295	0.174	0.095
	92	0.968	0.969	0.967	0.961	0.951	0.932	0.902	0.851	0.771	0.654	0.504	0.346	0.211	0.118
	93	0.972	0.973	0.972	0.967	0.958	0.943	0.918	0.876	0.807	0.703	0.561	0.401	0.254	0.145
	94	0.975	0.977	0.975	0.972	0.965	0.953	0.932	0.897	0.838	0.747	0.617	0.459	0.302	0.178
	95	0.978	0.979	0.979	0.976	0.970	0.960	0.943	0.914	0.866	0.787	0.670	0.517	0.355	0.217
	96	0.980	0.982	0.982	0.980	0.975	0.967	0.953	0.929	0.889	0.822	0.718	0.576	0.412	0.261
	97	0.983	0.984	0.984	0.983	0.979	0.972	0.961	0.942	0.908	0.852	0.762	0.632	0.471	0.311
	98	0.985	0.986	0.986	0.985	0.982	0.977	0.968	0.952	0.925	0.878	0.802	0.685	0.531	0.366
	99	0.986	0.988	0.988	0.987	0.985	0.981	0.974	0.961	0.939	0.900	0.836	0.733	0.590	0.424
	100	0.988	0.990	0.990	0.989	0.988	0.984	0.978	0.968	0.950	0.919	0.865	0.777	0.647	0.484



Commercial at-sea sex marking

Monica Woods, 2011 intern

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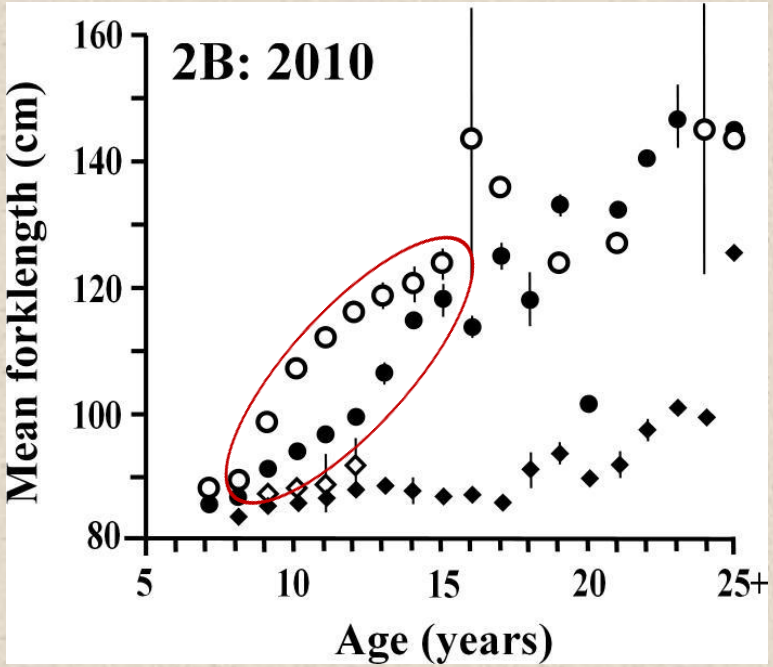

… but the fishery can encounter different dynamics.

Commercial at-sea sex marking

Our seven-stage plan:

1) Develop physical-marking protocols for commercial application

Commercial at-sea sex marking

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- **Similar to the "V-notch" program for Atlantic lobster fisheries**

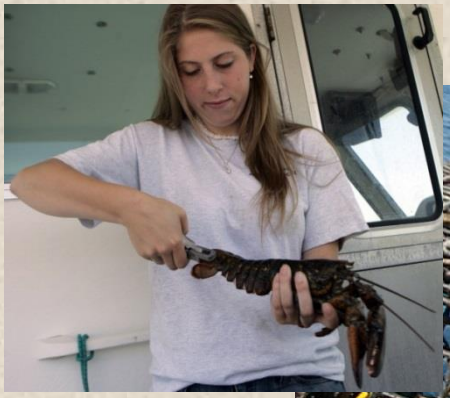

Photo: Associated Press

Photo: NMFS-NEFSC

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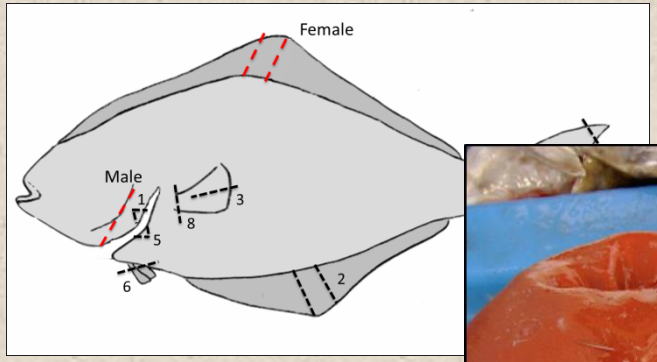
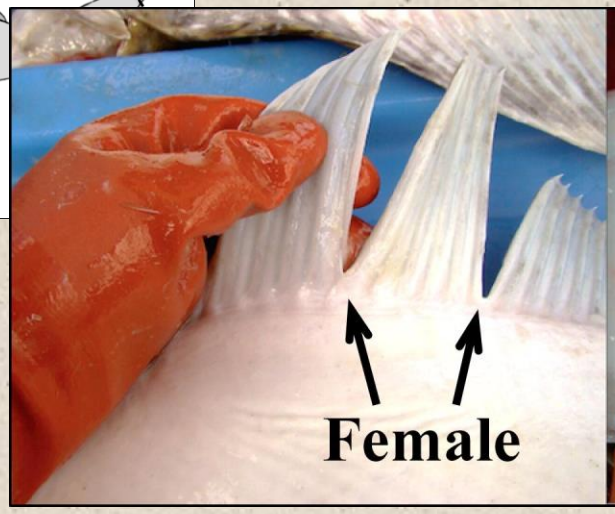
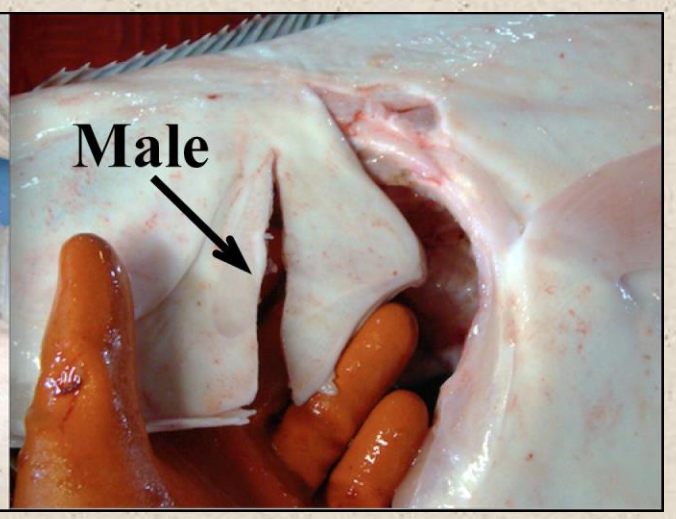
   - **Orion McCarthy, 2014**



Derived simple sex-specific knife cuts





Commercial at-sea sex marking

Photo: Homer News

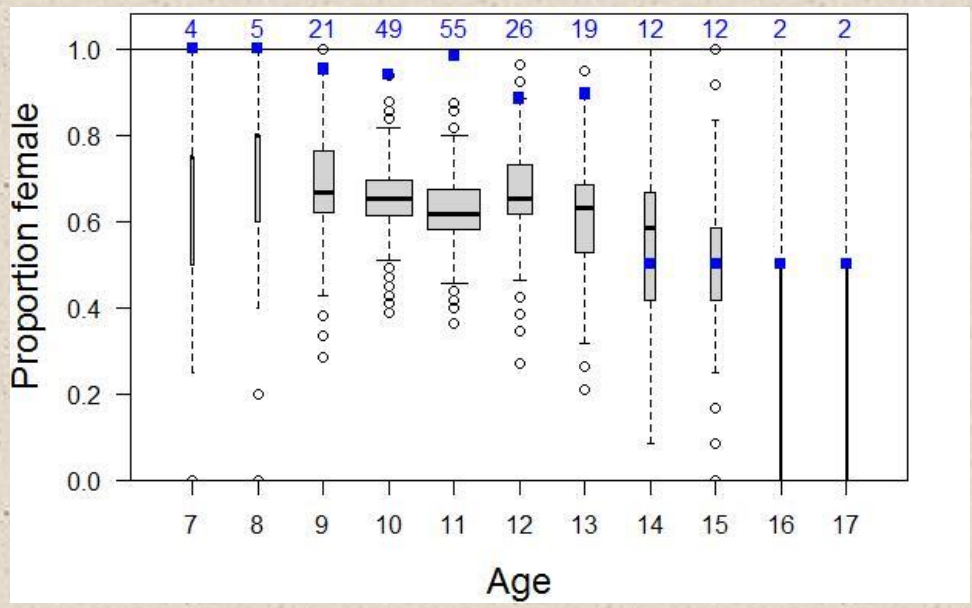
Jessica Marx, port sampler

Our seven-stage plan:

1) **Develop physical-marking protocols for commercial application**

2) **Small-scale test with volunteer vessels: Homer, 2015**

- **Confirmed the feasibility of the method**
- **Re-confirmed departures in sex ratio relative to survey-based expectations**



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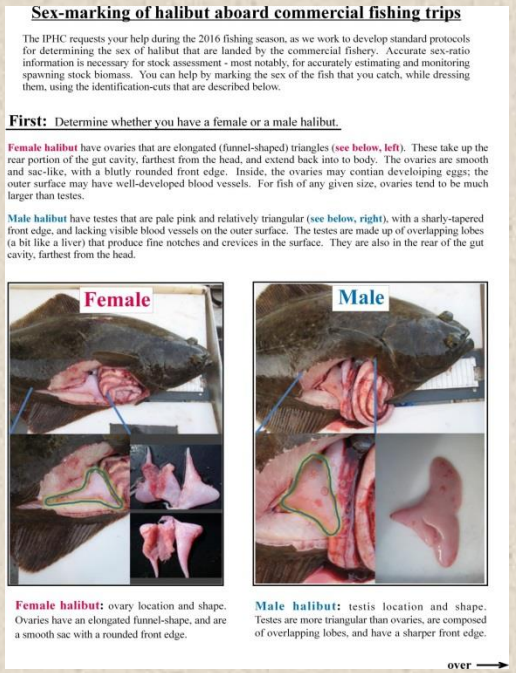


Sex-marking of halibut aboard commercial fishing trips

The IPHC requests your help during the 2016 fishing season, as we work to develop standard protocols for determining the sex of halibut that are landed by the commercial fishery. Accurate sex-ratio information is necessary for stock assessment - most notably, for accurately estimating and monitoring spawning stock biomass. You can help by marking the sex of the fish that you catch, while dressing them, using the identification-cuts that are described below.

First: Determine whether you have a female or a male halibut.

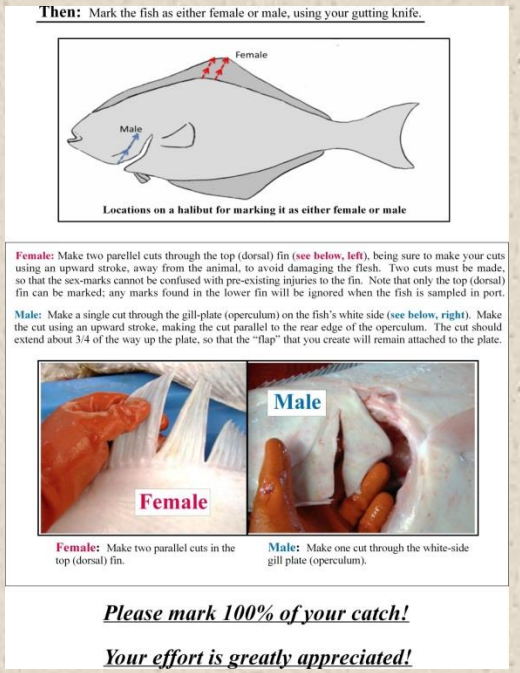
Female halibut have ovaries that are elongated (funnel-shaped) triangles **(see below, left)**. These take up the rear portion of the gut cavity, farthest from the head, and extend back into to body. The ovaries are smooth and sac-like, with a blutly rounded front edge. Inside, the ovaries may contian develoiping eggs; the outer surface may have well-developed blood vessels. For fish of any given size, ovaries tend to be much larger than testes.

Male halibut have testes that are pale pink and relatively triangular **(see below, right)**, with a sharly-tapered front edge, and lacking visible blood vessels on the outer surface. The testes are made up of overlapping lobes (a bit like a liver) that produce fine notches and crevices in the surface. They are also in the rear of the gut cavity, farthest from the head.

Female halibut: ovary location and shape. Ovaries have an elongated funnel-shape, and are a smooth sac with a rounded front edge.

Male halibut: testis location and shape. Testes are more triangular than ovaries, are composed of overlapping lobes, and have a sharper front edge.

over →



Then: Mark the fish as either female or male, using your gutting knife.

Locations on a halibut for marking it as either female or male

Female: Make two parellel cuts through the top (dorsal) fin **(see below, left)**, being sure to make your cuts using an upward stroke, away from the animal, to avoid damaging the flesh. Two cuts must be made, so that the sex-marks cannot be confused with pre-existing injuries to the fin. Note that only the top (dorsal) fin can be marked; any marks found in the lower fin will be ignored when the fish is sampled in port.

Male: Make a single cut through the gill-plate (operculum) on the fish's white side **(see below, right)**. Make the cut using an upward stroke, making the cut parallel to the rear edge of the operculum. The cut should extend about 3/4 of the way up the plate, so that the "flap" that you create will remain attached to the plate.

Female: Make two parallel cuts in the top (dorsal) fin.

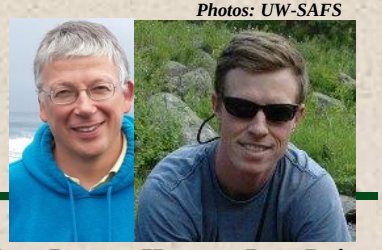
Male: Make one cut through the white-side gill plate (operculum).

Please mark 100% of your catch!

Your effort is greatly appreciated!

Commercial at-sea sex marking

Photos: UW-SAFS



Drs. Lorenz Hauser, Dan Drinan

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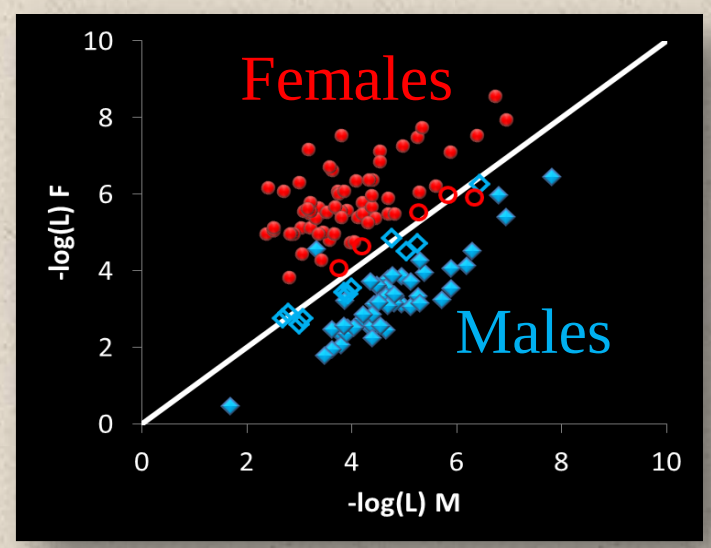
4) **Develop a genetic sex assay: UW School of Fisheries, 2016-2017**



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5) Coastwide voluntary sex-marking: beginning 2017
6) Examine the data … : 2017-2018
7) Routine comprehensive Data Stream: 2019 onward

Tags #1: ontogenic migration

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A Tale of Two Ghosts!!

The Ghost of Halibut almost-Present

"Why would we ever release a halibut without a tag on it?"

Steve Martell: IPHC Policy Analyst, 2013-2016

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+

The Ghost of Halibut Past

"How does bycatch affect downstream Regulatory Areas?"

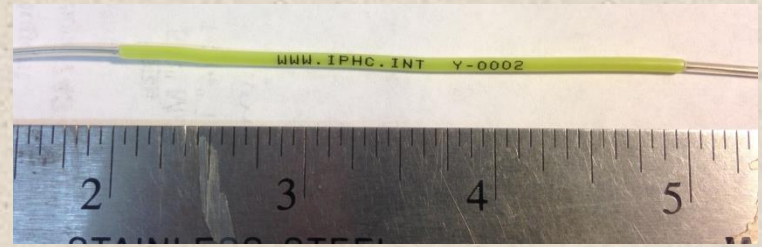
Dick Beamish: IPHC Commissioner, 1990-2005

= Examine dispersal from nursery-age through fishery recruitment

Tags #1: ontogenic migration

Opercular wire tagging on NMFS trawl and 4D Edge surveys

- Examine dispersal from (not-exactly) nursery areas through fishery recruitment: in a not-very-quantitative sense …



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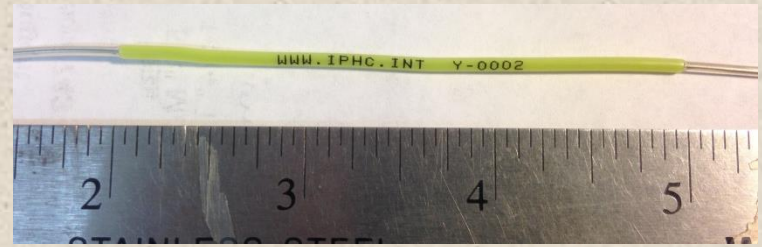
2015: only NMFS trawl surveys

- **Tagging took place on IPHC-staffed vessels (one Bering; one Gulf of Alaska)**
- **50% of fish were sampled for aging; 50% were tagged with opercular wire tags**
- **1,997 halibut (mostly U32) were tagged:**
  - **1,491 in the Gulf**
  - **485 in the Eastern Bering Sea**



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2016: NMFS BSAI trawl and IPHC setline in 4D and 4B

- **763 halibut (*all* U32) were tagged:**
  - **594 on trawl survey = 424 Bering + 170 Aleutian**
  - **169 on setline survey = 121 on the 4D Edge and 48 in 4B**

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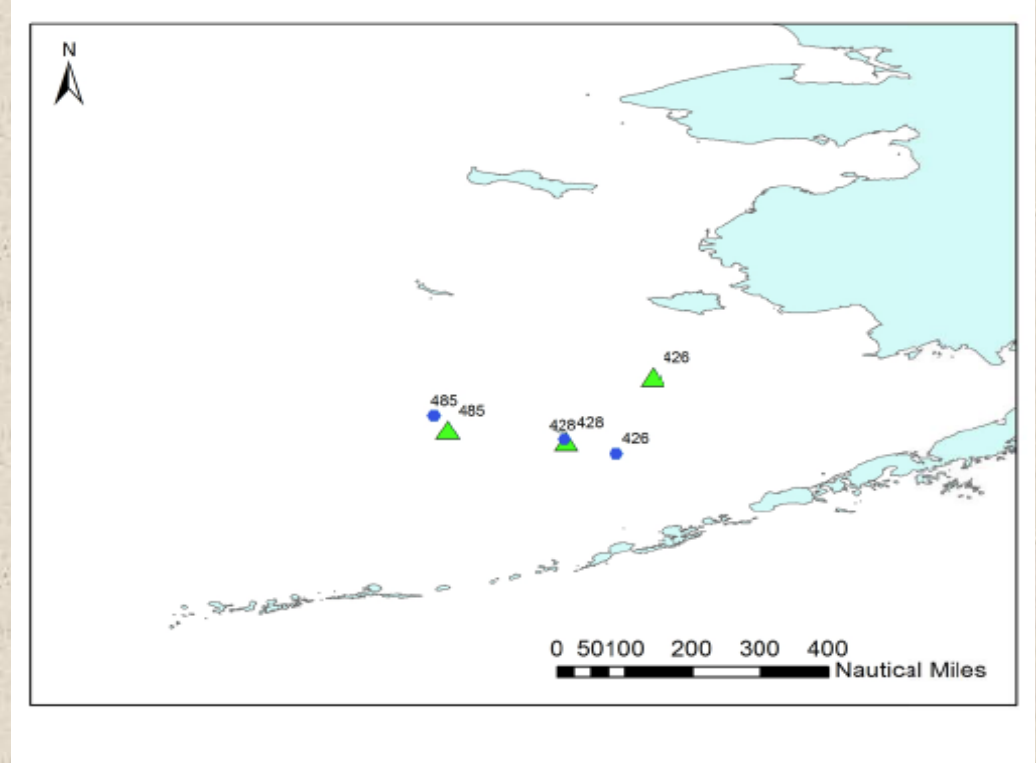
As of May …

- (3) Bering Sea tags were recovered by NMFS observers last August



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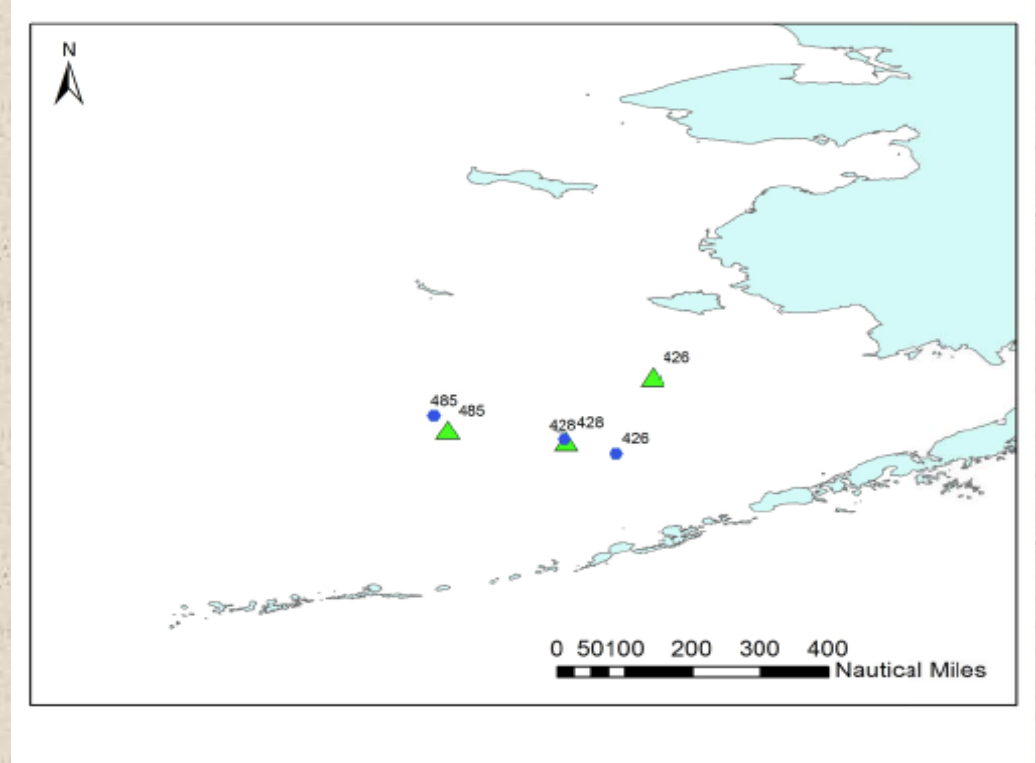

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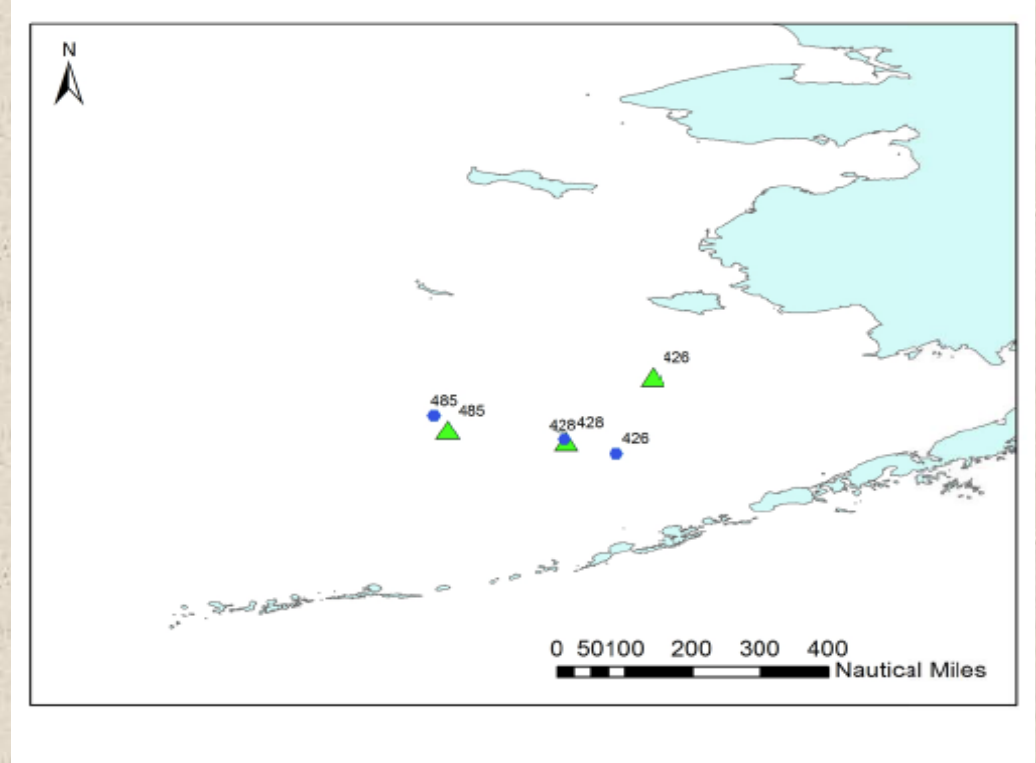
As of May …

- (3) Bering Sea tags were recovered by NMFS observers last August
- (1) Released in Area 2C was recovered in the winter salmon troll fishery
- (2) More Gulf tags recovered so far this year: (1) longline, (1) trawl (both close to release site)

0.3% Recovery rate! SWEET!



Tags #2: EBS PAT tagging

Photo: Rich Rosenthal

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Pop-up Archival Transmitting (PAT) tags:

Computerized tag that records light, depth, temperature

- **tag is darted into the fish, just below the dorsal fin**
- **releases on a pre-determined date and broadcasts to ARGOS satellites**

Photo courtesy of Kelly Attridge

Result: unbiased "recovery" data no matter where the fish has gone

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Photo: Rich Rosenthal

Expansion of 2 studies:

Interannual Dispersal - Seasonal Migration

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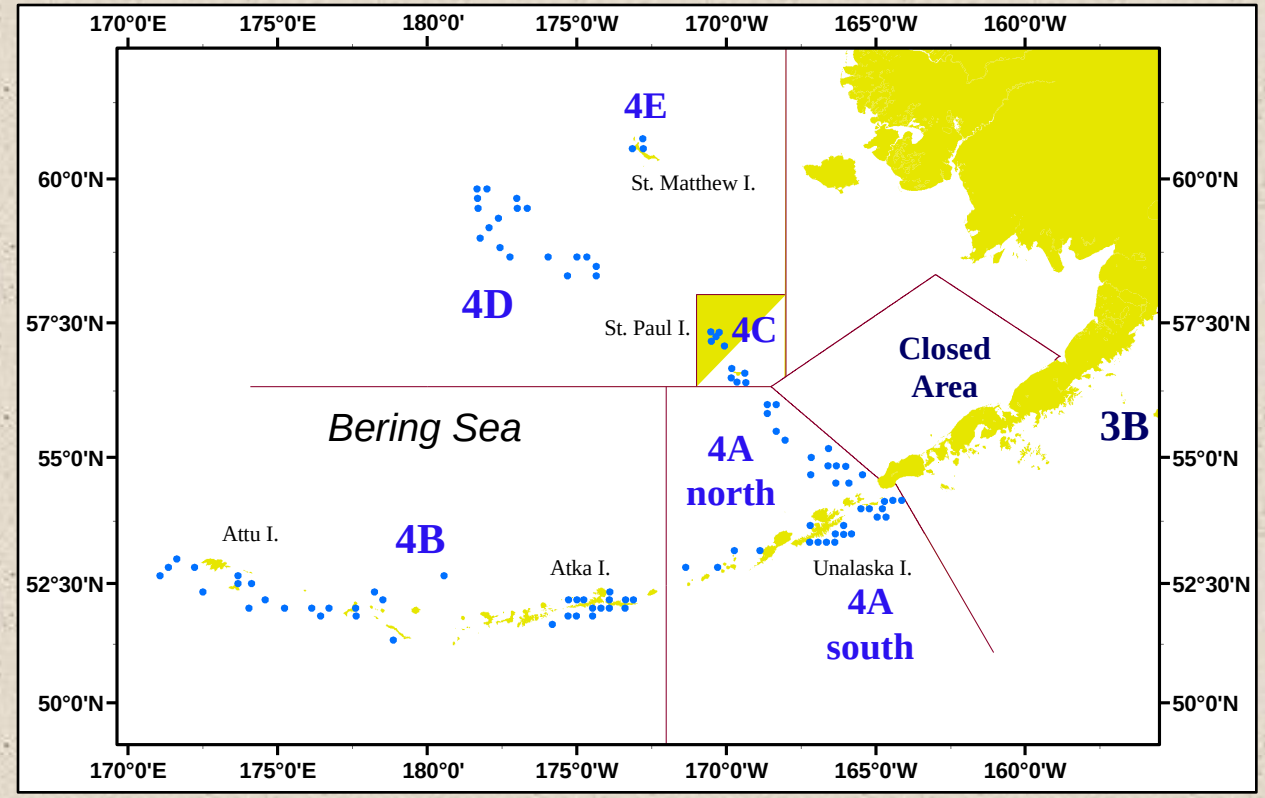
Interannual Dispersal - **Seasonal Migration**

The 2008-2010 Pop-up Archival Transmitting (PAT) tag study:



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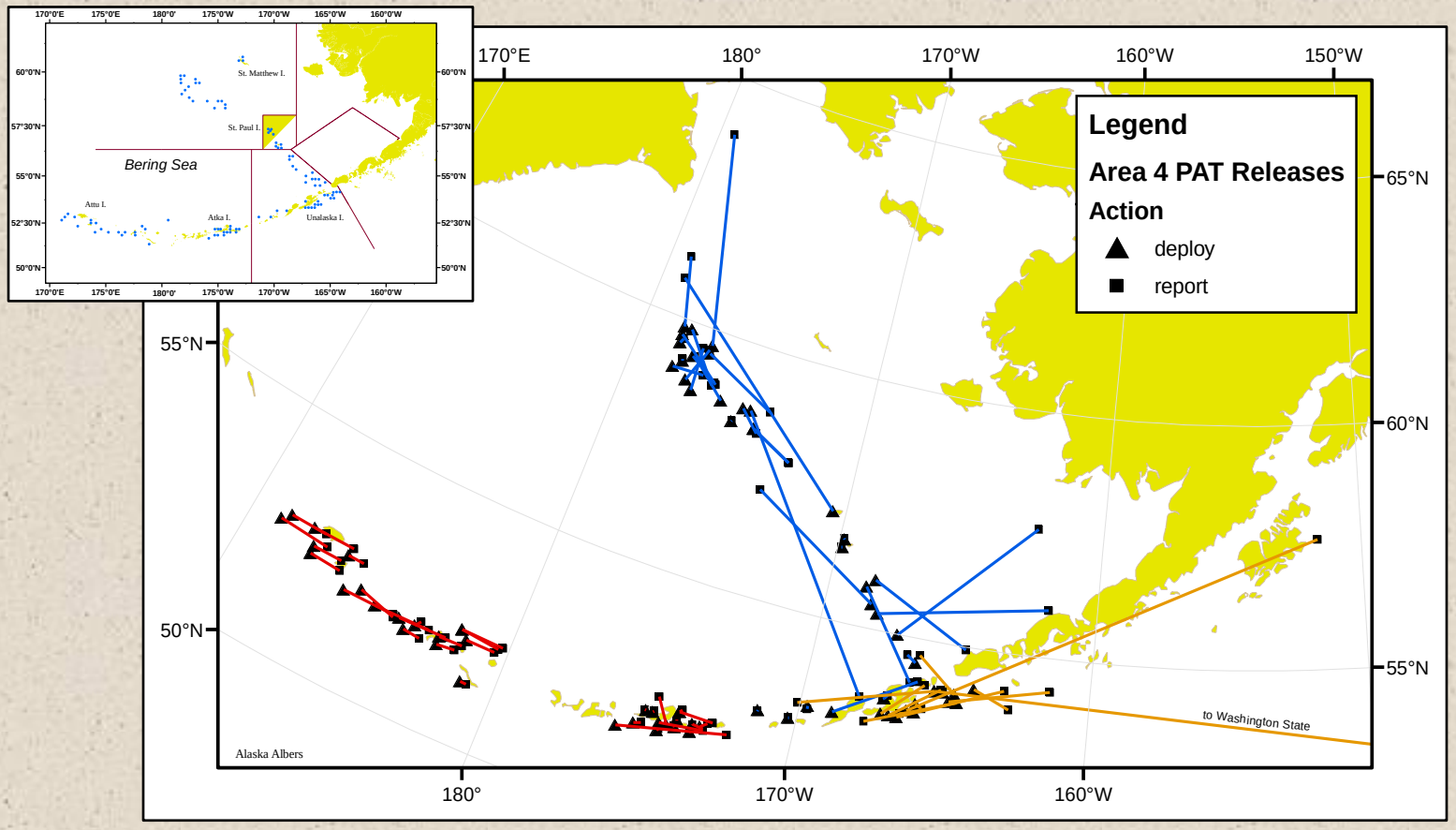

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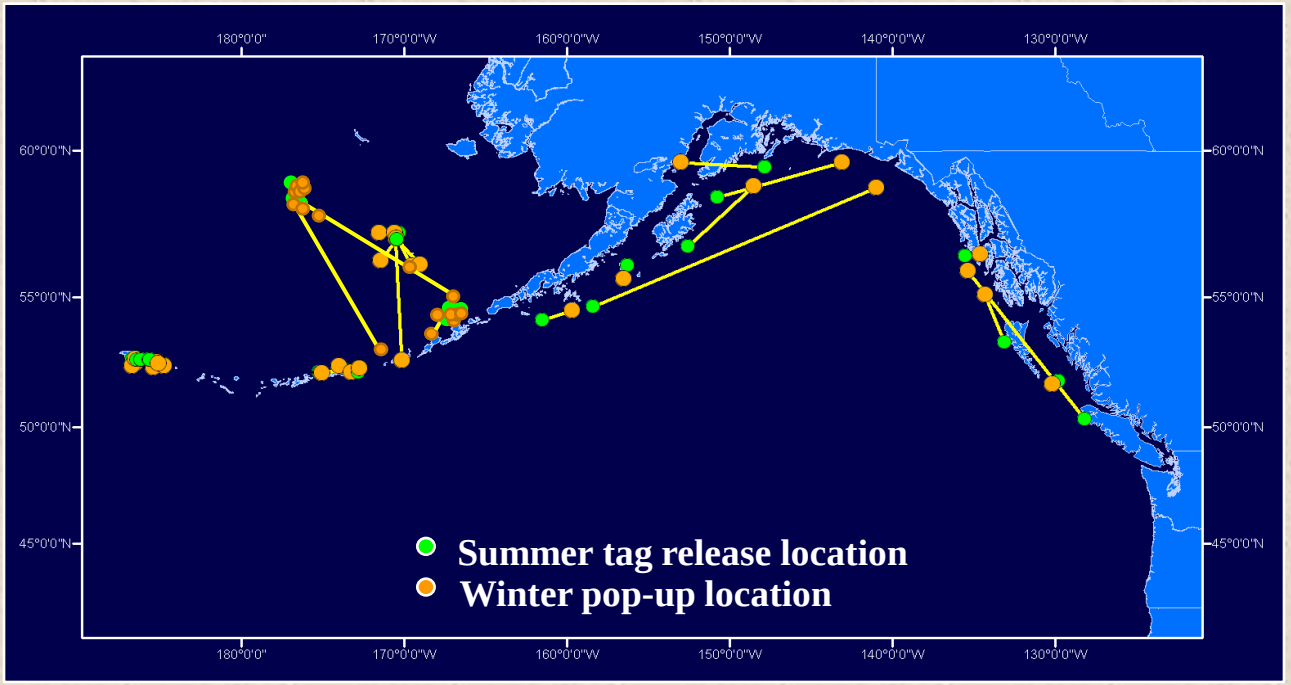

Location of spawning grounds in poorly-studied areas (i.e., Bering-Aleutian)

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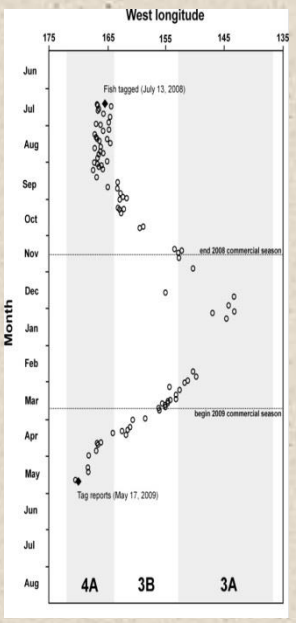

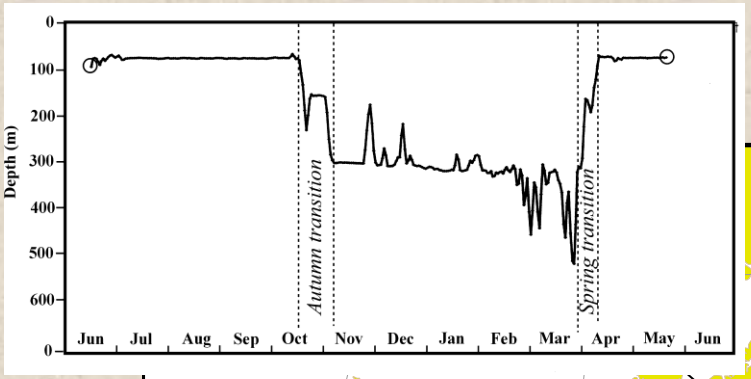

Timing of offshore-onshore and trans-boundary movements

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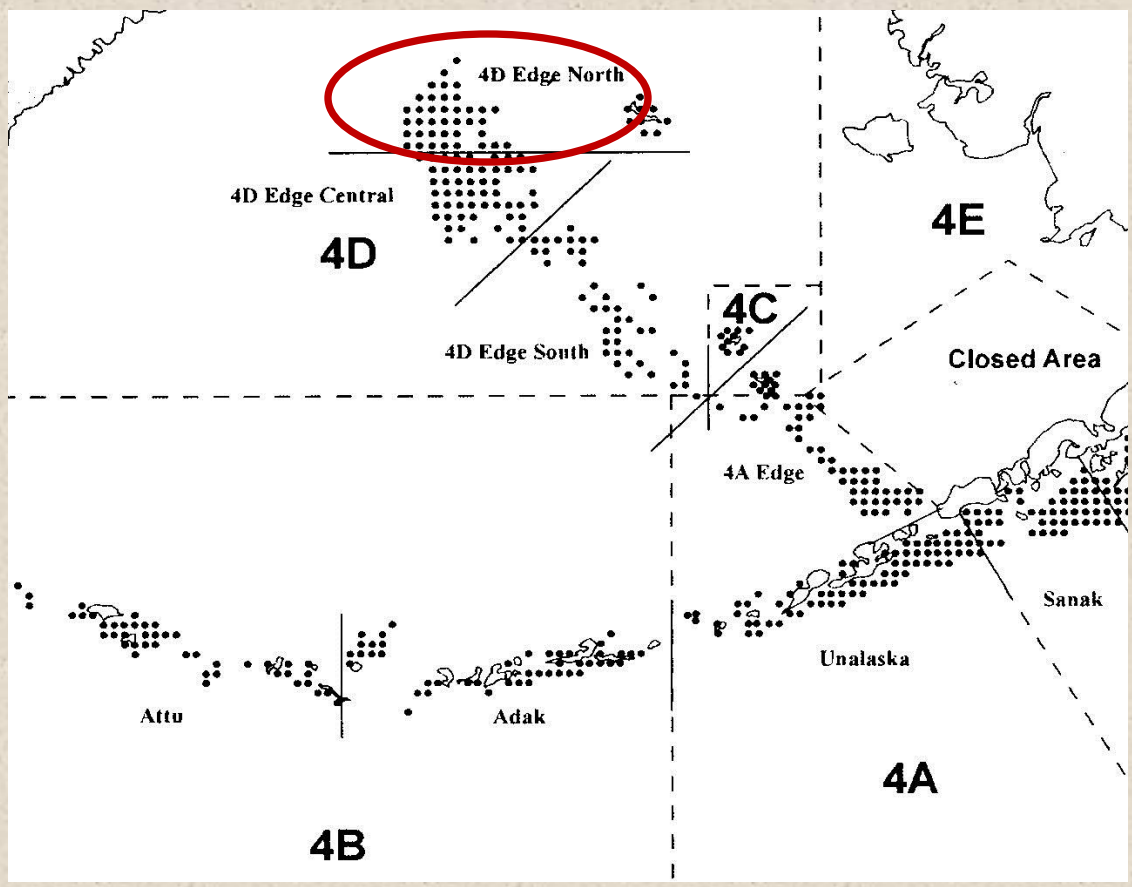
The caveat: we had never surveyed all the way to the Russian border



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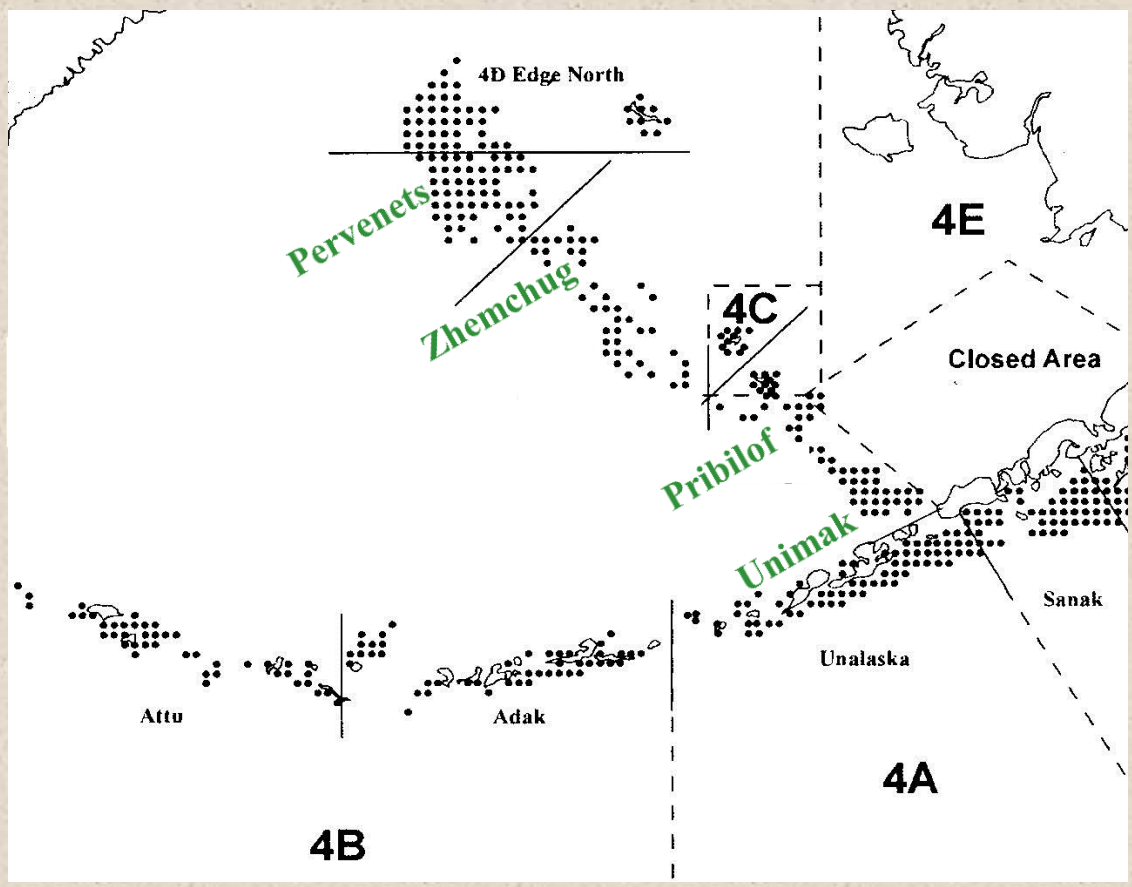

Photo: Rich Rosenthal

Tags #2: EBS PAT tagging

Expansion of 2 studies:

Interannual Dispersal - Seasonal Migration

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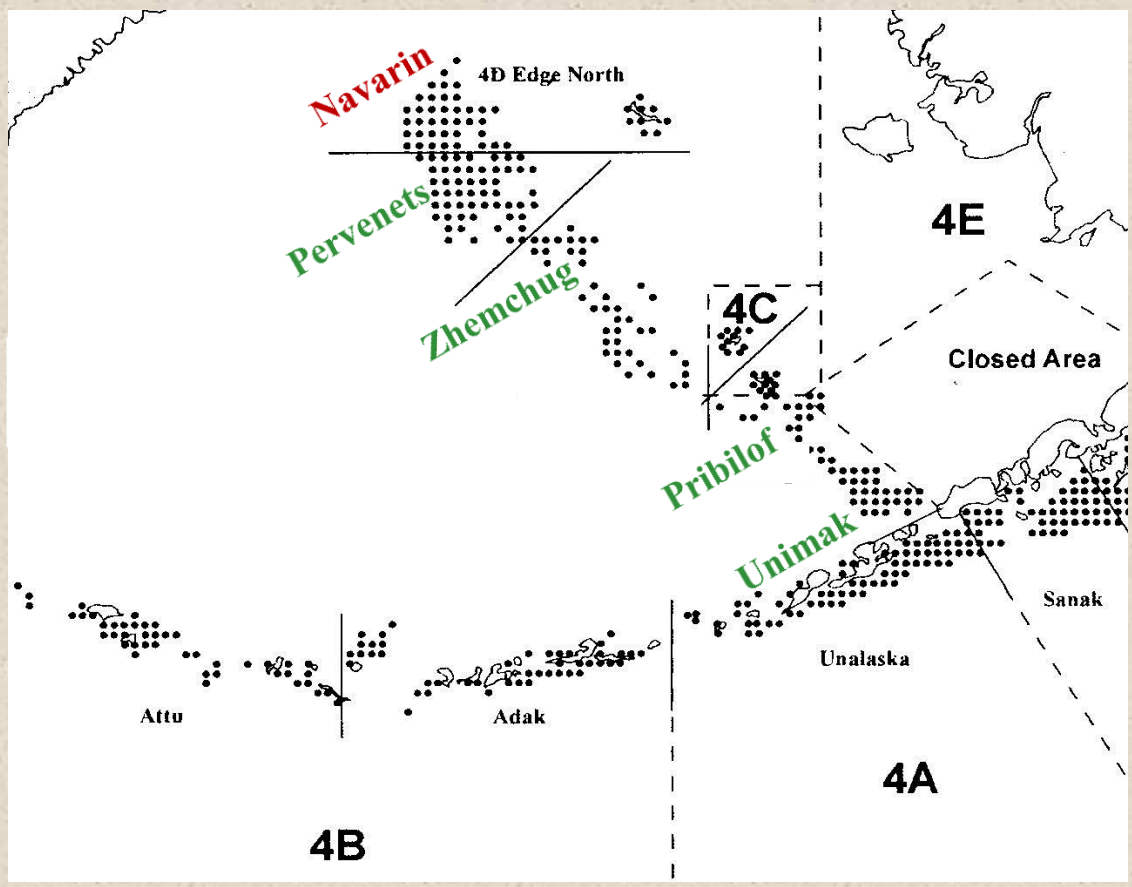

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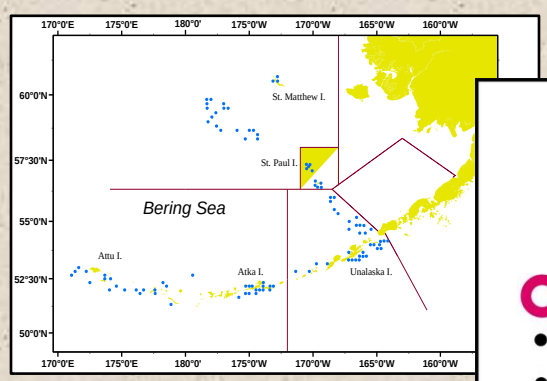
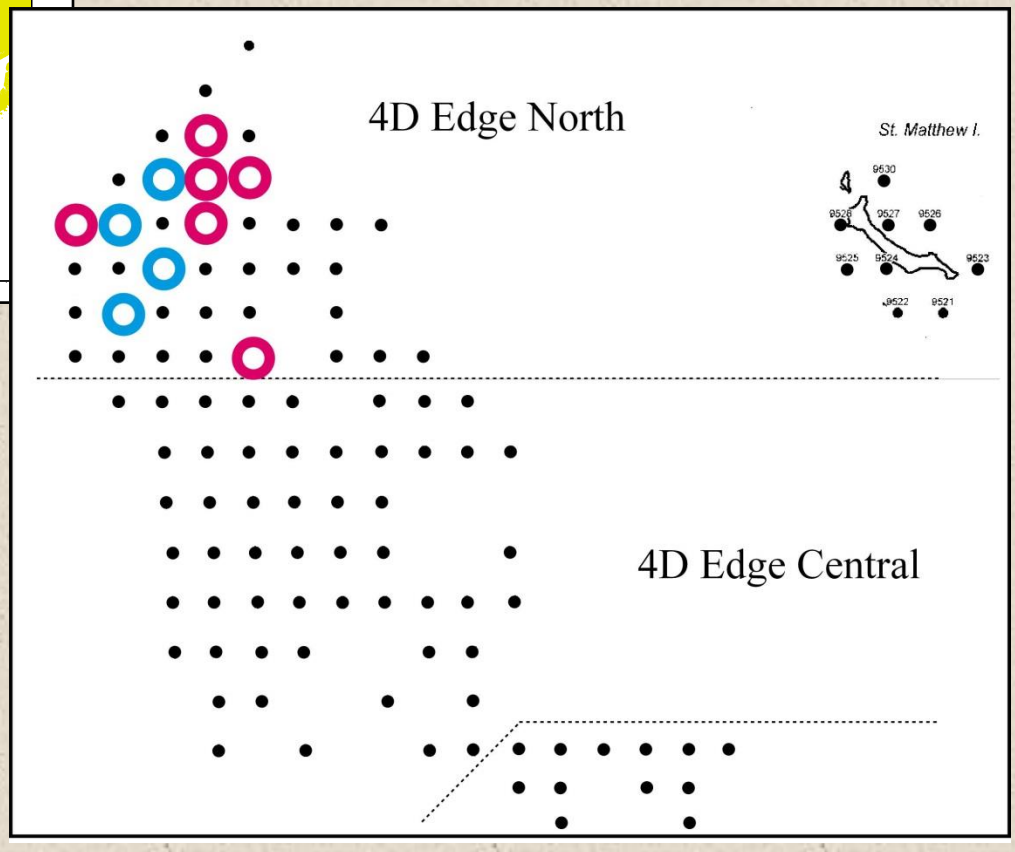


(11) Halibut (7 female; 4 male); 89-135 cm



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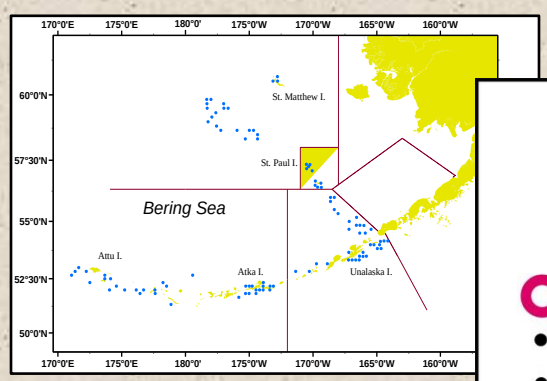
Interannual Dispersal - **Seasonal Migration**



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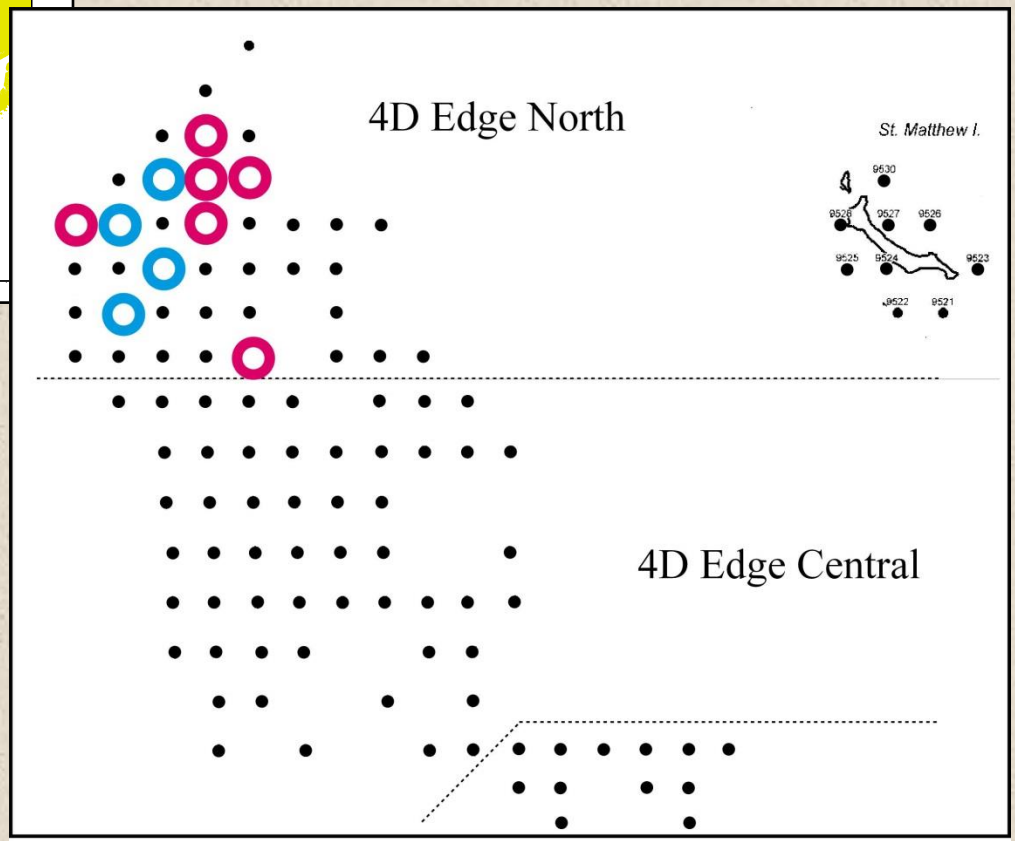

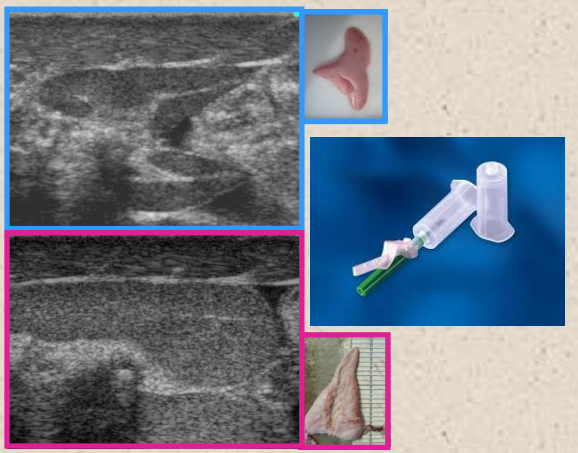

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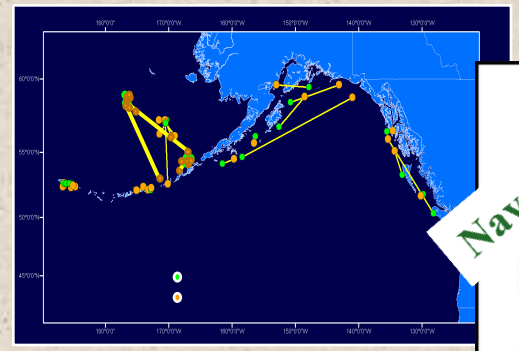
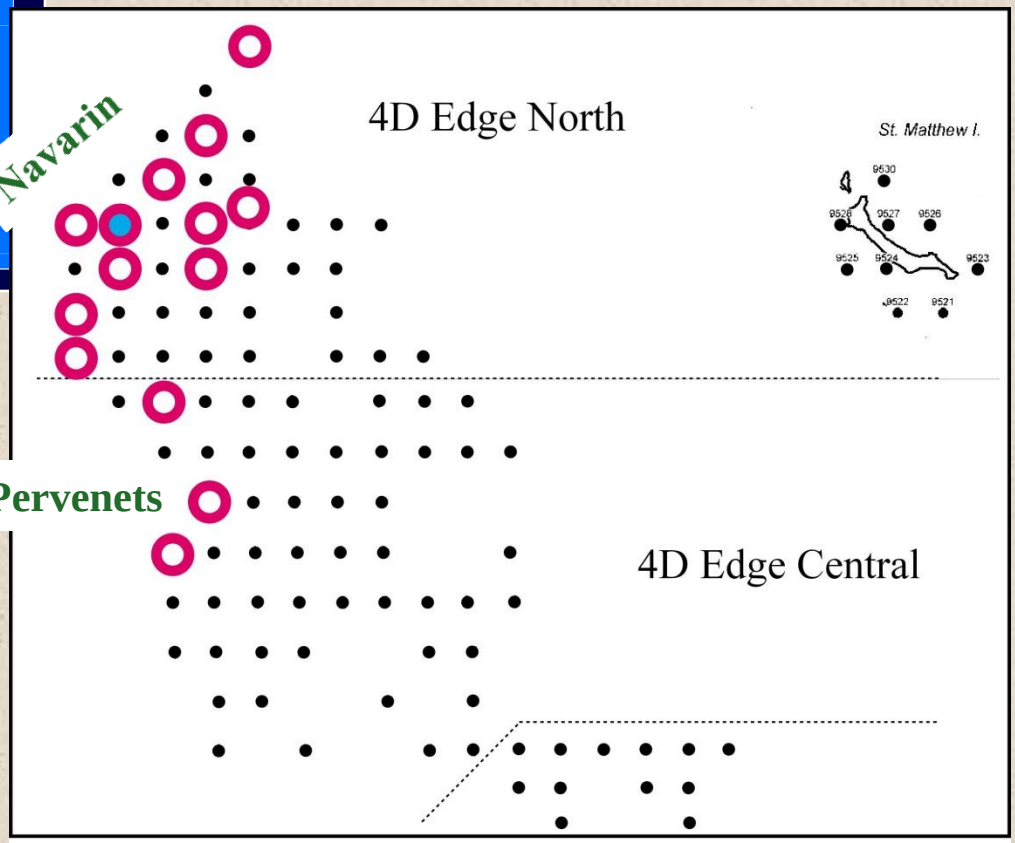
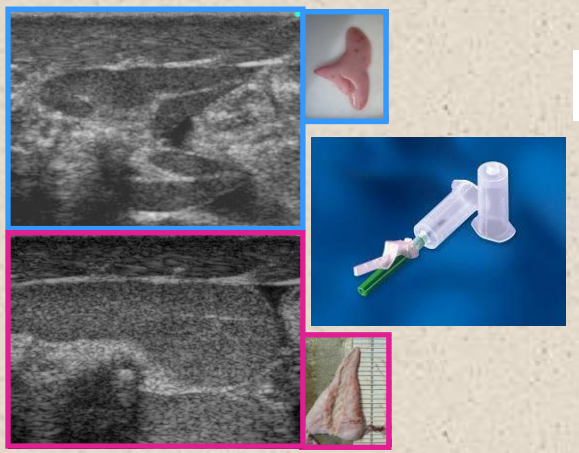
Interannual Dispersal - Seasonal Migration

(20) Halibut (17 female; 3 male); 92-167 cm







Tags #3: Trawl bycatch mortality

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Does “expedited release” lead to increased halibut survival?

Primary question:

- **What can be done to redistribute catch back to the directed fishery?**

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- **What can be done to redistribute catch back to the directed fishery?**
  - **A-80 Trawl Fleet suggests "expedited release"**
    (a.k.a., putting halibut back into the sea instead of leaving them on deck)

    … noting that this is not strictly legal

Tags #3: Trawl bycatch mortality

Does "expedited release" lead to increased halibut survival?

The research*:

- **Get an Experimental Fishing Permit (EFP) to allow selected trawlers to practice expedited release**

***Collaborating with the Alaska Seafood Cooperative (John Gauvin), FishNext Research (Craig Rose), Spearfish Research (Paige Drobny), UAF (Julie Nielsen and Andy Seitz), Wildlife Computers (Todd Lindstrom and Natalie Crandall), and the IPHC.**

Tags #3: Trawl bycatch mortality

Does "expedited release" lead to increased halibut survival?

The research:

- Get an Experimental Fishing Permit (EFP) to allow selected trawlers to practice expedited release
- Tag released fish (n=160*) with PAT tags set to release in 60 days
  - This is the standard "mortality window"

*Plus 20 tags that we put on healthy longline-caught fish, dead carcasses, and moorings.

Tags #3: Trawl bycatch mortality

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The research:

- Get an Experimental Fishing Permit (EFP) to allow selected trawlers to practice expedited release
- Tag released fish (n=160*) with PAT tags set to release in 60 days
  - This is the standard "mortality window"
- Compare their mortality with average rates that are currently applied to the fishery

  … noting that premature tag pop-ups are used to indicate death of the host fish

*Plus 20 tags that we put on healthy longline-caught fish, dead carcasses, and moorings

Tags #3: Trawl bycatch mortality

Does “expedited release” lead to increased halibut survival?

Problem:

- **How do I know if the fish was really dead when the tag popped off?**

Photo: UAF-Juneau

Julie Nielsen, UAF

Tags #3: Trawl bycatch mortality

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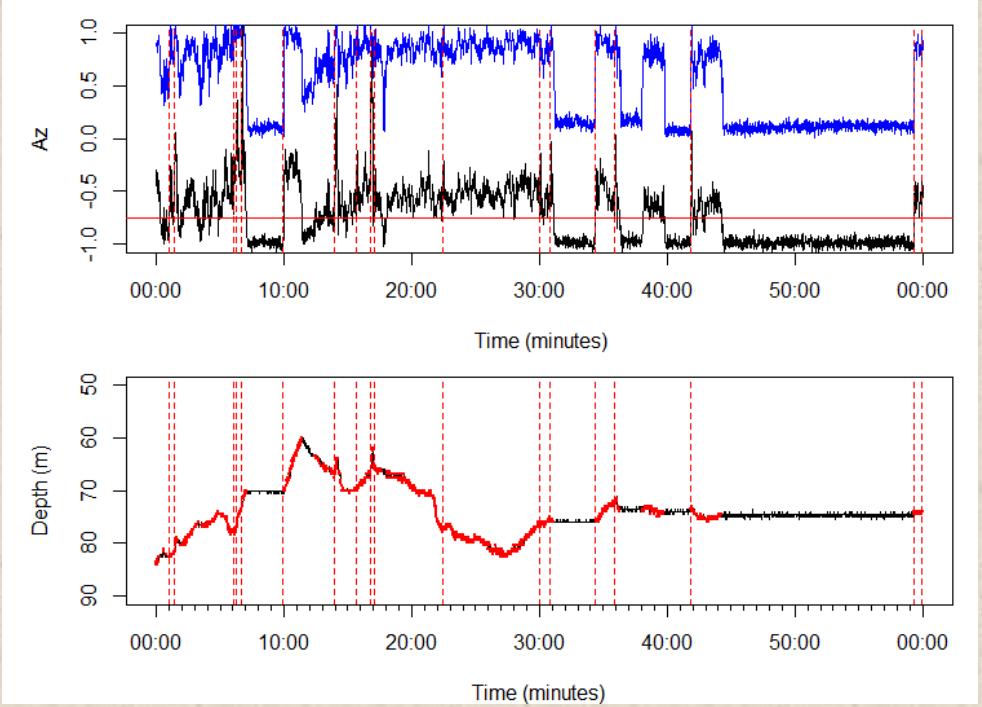
Acceleration!



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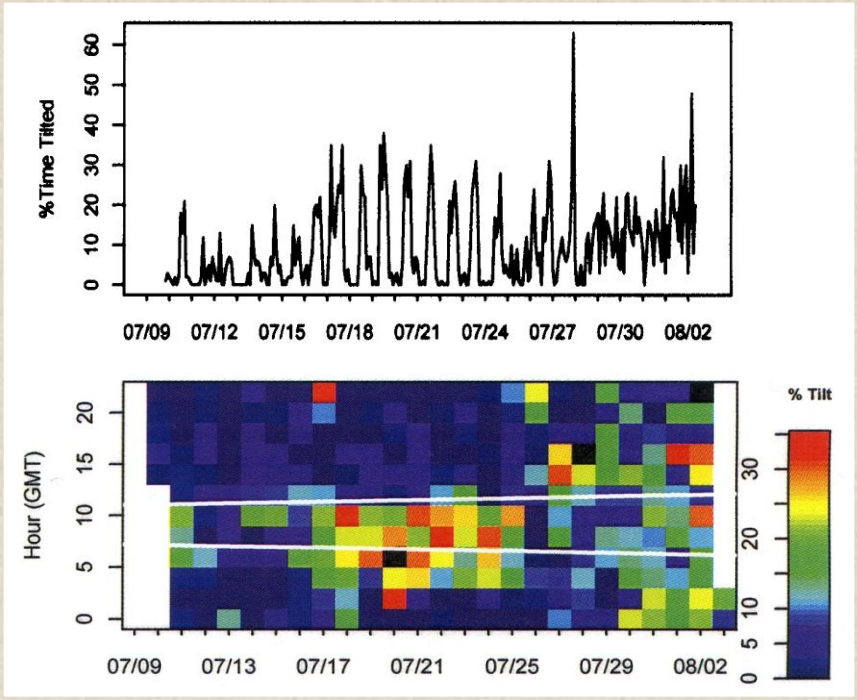
Does "expedited release" lead to increased halibut survival?

- **Broadcast data are summarized as "knockdowns" and tilt %**

Healthy halibut



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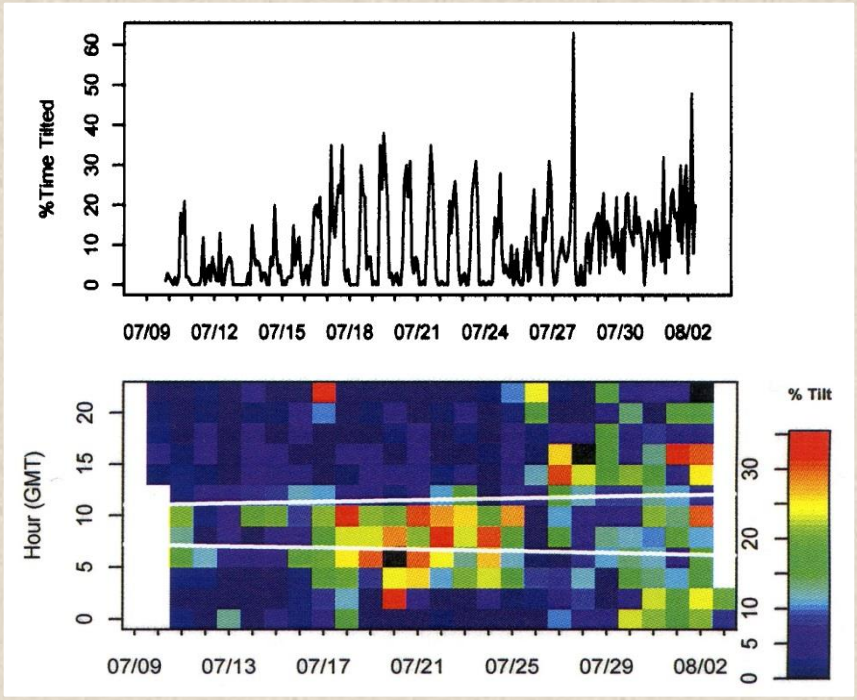
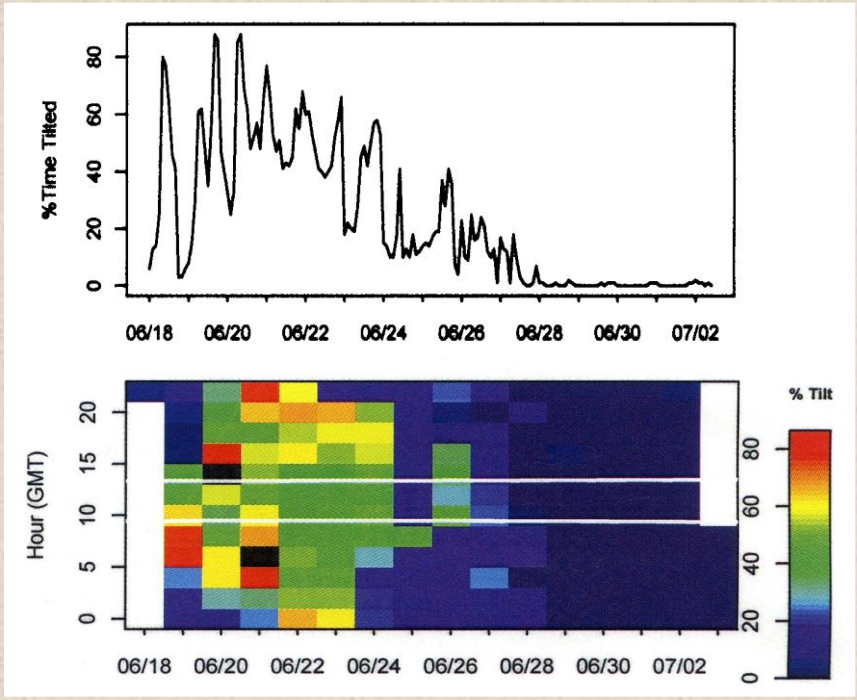


Presumed mortality



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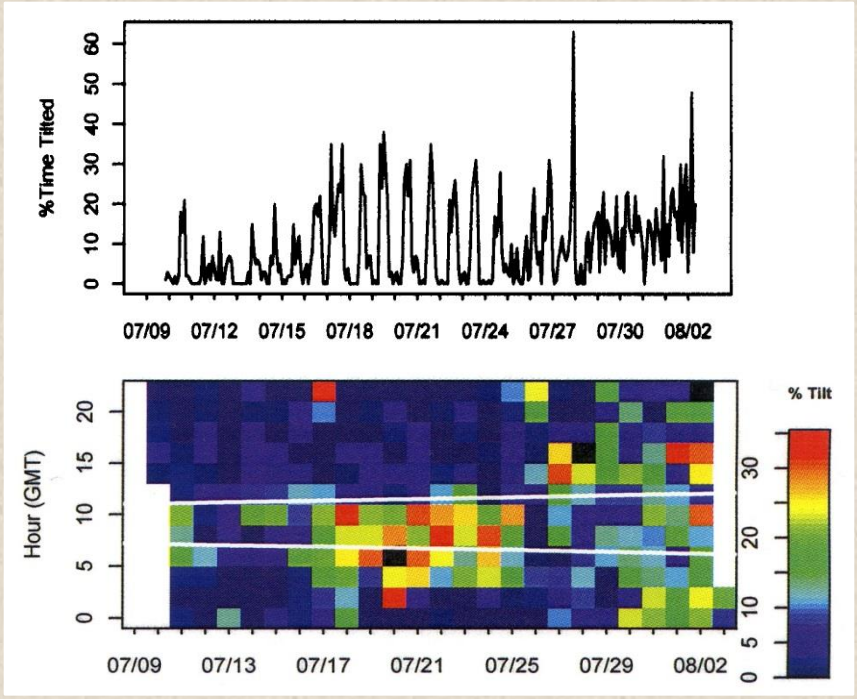

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