

Christine Stawitz

3/8/2016

**Project Update Narrative: NMFS/Sea Grant Fellowship: E/I-24 - Population and Ecosystem Dynamics - Evaluating the importance of growth variation in marine fish population dynamics and stock assessment**

As part of this fellowship, my proposed objectives were to conduct a two-part study on the relative importance of somatic growth to:

1. Quantify the relative effects of several growth and recruitment variability patterns on production across different life history archetypes.
2. Evaluate the consequences of growth variation on management reference point and growth parameter estimates under alternative life histories and fishing pressures.

Below I detail the progress I have made over the following year on both of these proposed objectives. In summary, I am progressing towards completion of both of these objectives in the next year, during which I intend to defend my PhD. I have nearly completed the first objective and will begin the second objective shortly.

**Part I: Quantify the relative effects of several growth and recruitment variability patterns on production across different life history archetypes.**

*Activities carried out:* In the past year, I have mostly completed this component of the proposed work. We are in final reviews of this paper between co-authors before submitting the paper for publication. Since last year, I have added to the population model I constructed to simulate populations of fish, added several species “archetypes” to the set of simulated data, included empirical time series of recruitment variation in this simulation, and presented the results of this analysis to an audience of fishery scientists at the 149<sup>th</sup> annual meeting of the American Fisheries Society in Portland, OR.

In this study, we projected population responses to realistic fluctuations in growth and early life history for eight fish species that spanned a gradient of life history traits (Table 1). First, we quantified characteristics of time series (i.e. autocorrelation, variance) of compiled recruitment (Stachura et al. 2014) and somatic growth (Stawitz et al. 2015) anomalies (deviations from average levels), which were then used to simulate recruitment and growth trajectories. These patterns were then combined with a standard age-structured population model to evaluate how variability in each rate is transmitted as variability in population biomass and production. Three alternative variation scenarios across three harvest scenarios were run for each species: 1) growth variability only, 2) recruitment variability only, and 3) growth and recruitment variability. By alternatively stabilizing each process, we quantified the relative contribution of each to population productivity.

*Participants:* My primary collaborator in this work was my advisor, Dr. Timothy E. Essington of the School of Aquatic and Fishery Sciences at the University of Washington. I also worked with Dr. Trevor A. Branch of UW and Dr. Melissa A. Haltuch and Dr. Anne B. Hollowed of NOAA Fisheries.

*Results:* We found that somatic growth variability often has at least as much influence as recruitment on marine fish population dynamics (Figure 1). This counters the widely held notion that recruitment variation is the primary cause of fluctuations in fish biomass (Hjort 1914, Cushing 1982). Our results suggest that the relative effect of different types of demographic variation on population variability

differs across species. Unexpectedly, we did not find strong correlations between life history characteristics and the importance of different processes (Figure 2). Rather the magnitude and autocorrelation of variation time series were more influential towards how each process drives productivity. More severe age truncation (through fishing) did increase the impact of recruitment variation on biomass variation, as expected, but either did not affect or decreased the effect of growth variation on biomass variation.

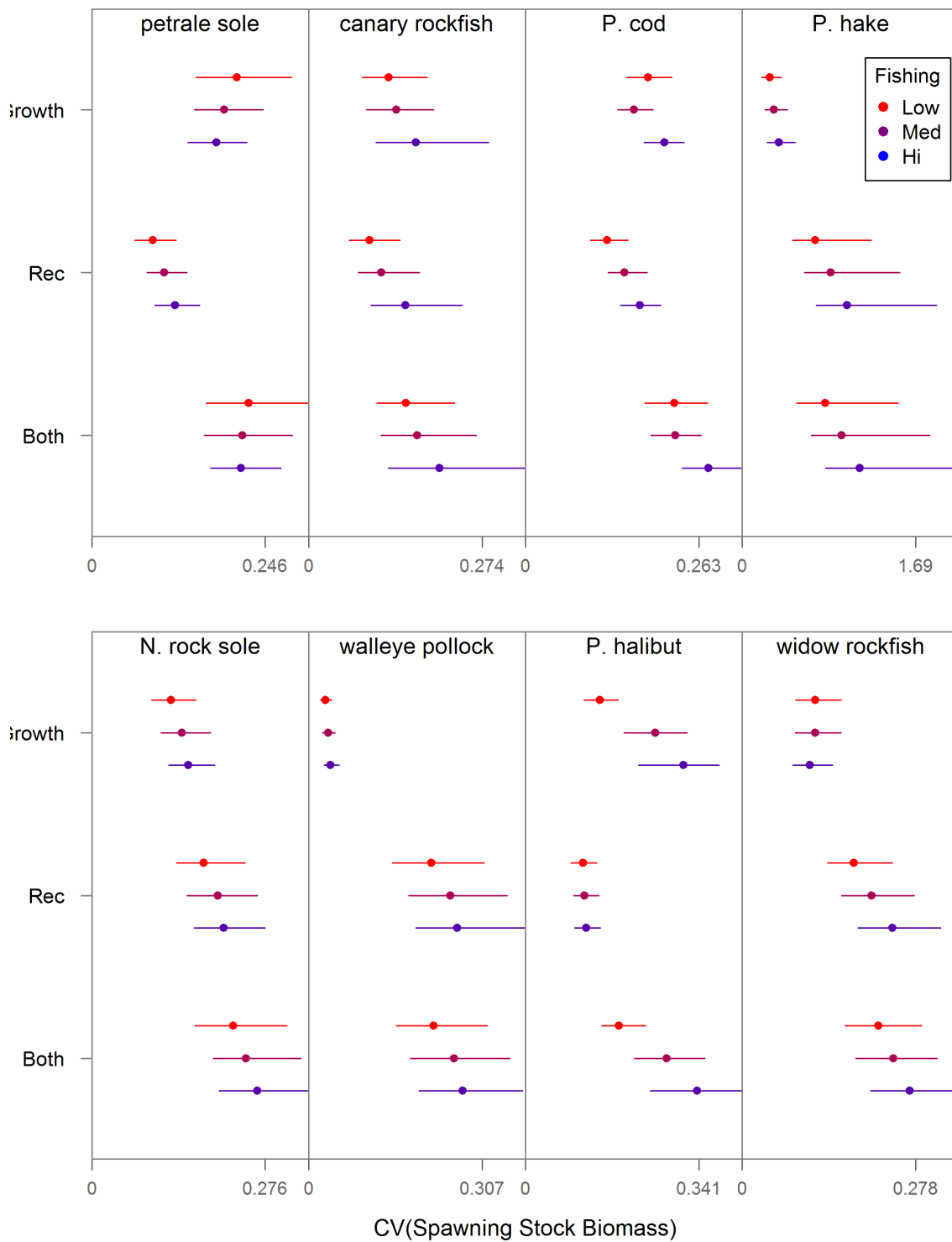


Figure 1 - 95% quantiles (lines) and medians (points) of spawning stock biomass CV across three harvest rates. “Growth” denotes scenarios with growth variation only, “Rec” denotes scenarios with recruitment variation only, and “Both” denotes scenarios with both types of variation.

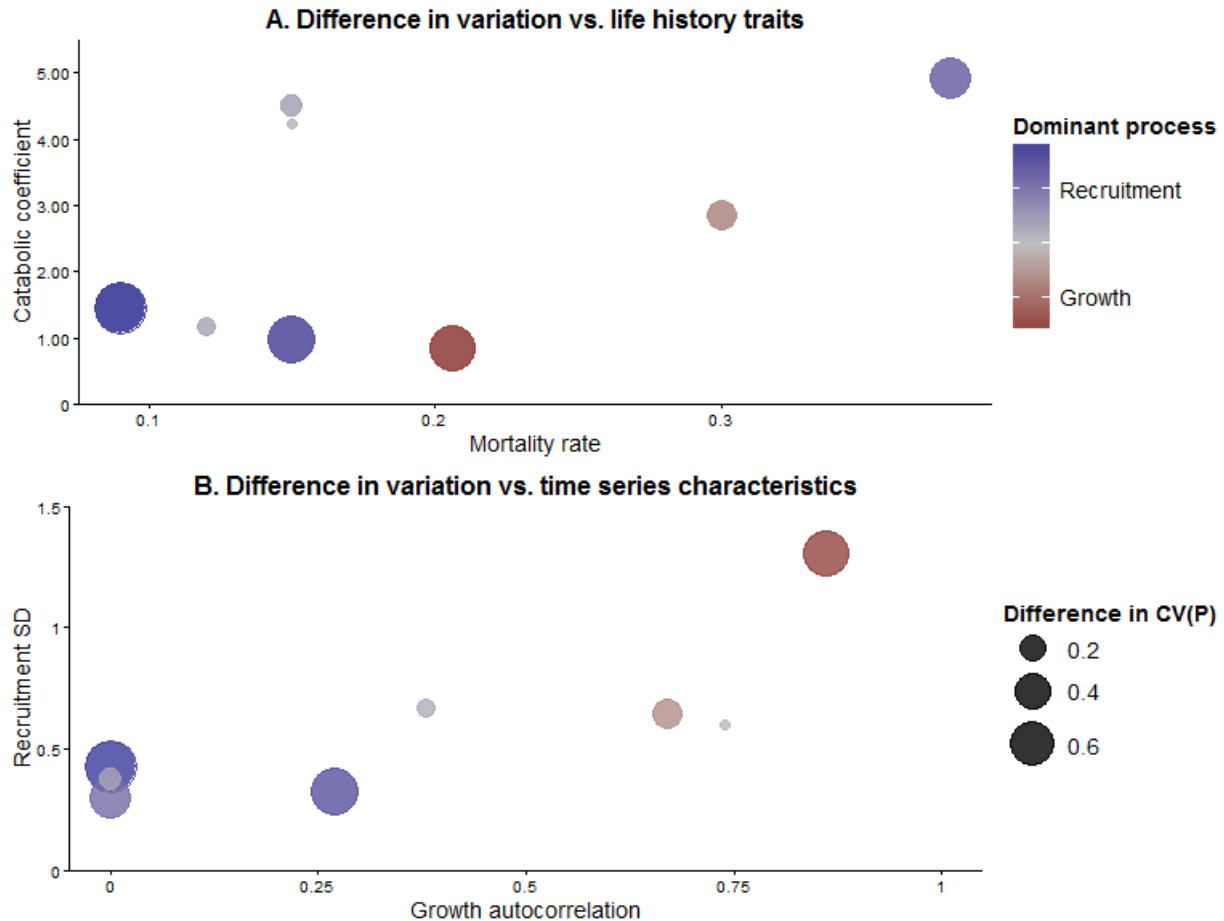


Figure 2- Colors and bubble size indicate relative dominance of growth (purple) or recruitment (red) variation (as measured by the difference of the median output CVs of annual production under medium harvest), against (a) the catabolic coefficient (A) compared with mortality rate (M) and (b) the standard deviation of recruitment deviations compared with autocorrelation of growth deviations.

Challenges encountered: None significant.

Changes in project direction: None, this is exactly what I proposed.

**Part II: Evaluate the consequences of growth variation on management reference point and growth parameter estimates under alternative life histories and fishing pressures.**

Activities carried out: Thus far, I have not completed any analysis on this component of the project beyond brainstorming.

Participants: I intend to collaborate with Dr. Timothy E. Essington and Dr. Melissa A. Haltuch, my NMFS mentor, on this project.

*Results: N/A*

*Challenges encountered: N/A*

*Change in project direction: N/A*

**REPORT**  
E/I-24  
03/01/2015 - 02/29/2016  
Submitted On: 03/09/2016 03:11:59 AM

**METRICS & MEASURES**

**Acres of coastal habitat**

Metric/Measure	Value	Note
Acres of coastal habitat		

**Fishermen and seafood industry personnel**

Metric/Measure	Value	Note
Fishermen and seafood industry personnel		

**Communities - economic and environmental development**

Metric/Measure	Value	Note
Communities - economic and environmental development		

**Stakeholders - sustainable approaches**

Metric/Measure	Value	Note
Stakeholders - sustainable approaches		

**Informal education programs**

Metric/Measure	Value	Note
Informal education programs		

**Stakeholders who receive information**

Metric/Measure	Value	Note
Stakeholders who receive information		

**Volunteer hours**

Metric/Measure	Value	Note
Volunteer hours		

### P-12 students reached

Metric/Measure	Value	Note
P-12 students reached		

### P-12 educators

Metric/Measure	Value	Note
P-12 educators		

## REQUESTED INFORMATION

### Publications

#### **Stock assessment update: Status of the US petrale sole resource in 2014**

**Publication Type:** Technical Reports (peer-reviewed)

**Publication Year:** 2015

**Publication Authors:**

**Publisher Info:** Pacific Fishery Management Council

**Notes:** Government report on petrale sole status in 2014.

**Related URLs:** <http://www.pcouncil.org/groundfish/stock-assessments/by-species/petracle-sole/>

**Keywords:**

**Publication URLs:**

**Abstract:**

**Citation:** Stawitz, C.C., Hurtado-Ferro, F., Kuriyama, P.T., Trochta, J.T., Johnson, K.F., Haltuch, M.A., Hamel, O.S. Stock Assessment Update: Status of the U.S. petrale sole resource in 2014. 2015. Pacific Fishery Management Council, Portland, OR.

**Citation for Coverage:**

**SG can post PDF online?:** No

**Uploaded File:**

#### **The effect of length bin structures on growth estimation in integrated age-structured stock assessments.**

**Publication Type:** Peer-reviewed: Journals (incl. articles), Books, Proceedings, and Other Documents

**Publication Year:** 2015

**Publication Authors:**

**Publisher Info:** Fisheries Research

**Notes:**

**Related URLs:**

**Keywords:**

**Publication URLs:**

**Abstract:**

**Citation:** Monnahan, C.C., Ono, K., Anderson, S.C., Rudd, M.B., Hicks, A.C., Hurtado-Ferro, F., Johnson, K.F., Kuriyama, P.T., Licandeo, R.R., Stawitz, C.C., Taylor, I.G., Valero, J.L. In press. The effect of length bin structures on growth estimation in integrated age-structured stock assessments.

Fisheries Research: Special issue on modeling growth in stock assessment models.

**Citation for Coverage:**

**SG can post PDF online?:** No

**Uploaded File:** [1-s2.0-S0165783615301259-main.pdf](#)

**An empirical weight-at-age approach reduces estimation bias compared to modeling parametric growth in integrated, statistical st**

**Publication Type:** Peer-reviewed: Journals (incl. articles), Books, Proceedings, and Other Documents

**Publication Year:** 2015

**Publication Authors:**

**Publisher Info:** Fisheries Research

**Notes:**

**Related URLs:**

**Keywords:**

**Publication URLs:**

**Abstract:**

**Citation:** Kuriyama, P.T., Ono, K., Hurtado-Ferro, F., Hicks, A.C., Taylor, I.G., Licandeo, R.R., Johnson, K.F., Anderson, S.C., Monnahan, C.C., Rudd, M.B., Stawitz, C.C., Valero, J.L. In press. A empirical weight-at-age approach reduces estimation bias compared to modeling parametric growth in integrated, statistical stock assessment models when growth is time varying. Fisheries Research: Special issue on modeling growth in stock assessment models.

**Citation for Coverage:**

**SG can post PDF online?:** No

**Uploaded File:**

## Students Supported

**Christine Stawitz** (Continuing Student)

[cstawitz@uw.edu](mailto:cstawitz@uw.edu)

**University of Washington, Quantitative Ecology and Resource Management**

**Field of Study:**

**Advisor:** Christine Stawitz

**Degree Type:** PhD

**Degree Year:** 2016

**Degree awarded this reporting period?:** No

**Student Project Title:** Somatic growth variation in marine fish: drivers and impacts for population production and assessment

**Involvement With Sea Grant This Period (capstone, fellow, intern, etc.):** Fellow

**Post-Graduation Plans (employer, grad school, etc.):** TBD

## Narratives

**Progress towards completing PhD dissertation.**

**Uploaded File:** [NMFSSeaGrant2016Update.docx](#)

## Partners This Period

**Fishery Resource Analysis and Monitoring Division, Northwest Fisheries Science Center (U DOC, NOAA, NMFS, NWFSC)**

**Types:** Government

**Scale:** FEDERAL or NATIONAL

**Notes:** I worked with Melissa Haltuch of NMFS on this project.



**Alaska Fisheries Science Center (US DOC, NOAA, NMFS)****Types:** Government**Scale:** FEDERAL or NATIONAL**Notes:** I worked with Anne Hollowed of NMFS on this project.**STANDARD QUESTIONS****Economic Impacts**No **Economic Impacts** information reported**Tools, Technologies, Information Services / Sea Grant Products****(1)**

<b>Description</b>	Analysis of impact of growth variation on population production, which is being submitted for publication.
<b>Developed (in the reporting period)?</b>	Yes
<b>Used (in the reporting period)?</b>	No
<b>Used for EBM?</b>	No
<b>ELWD product?</b>	No
<b>Number of managers</b>	0
<b>Description/Names of managers</b>	

**Community Hazard Resilience**No **Community Hazard Resilience** information reported**Meetings, Workshops, Presentations****(1)**

<b>Type of Event</b>	Public or professional presentation
<b>Description</b>	DTU Ocean Life Meeting
<b>Event Date</b>	10-07-2015
<b>Number of Attendees</b>	30

**(2)**

<b>Type of Event</b>	Public or professional presentation
<b>Description</b>	"The relative importance of somatic growth and recruitment variation in population production" at the American Fisheries Society Annual Meeting
<b>Event Date</b>	08-19-2015

<b>Number of Attendees</b>	80
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(3)

<b>Type of Event</b>	Public or professional presentation
<b>Description</b>	Stock Assessment Update: Status of the US Petrale Sole Resource in 2014
<b>Event Date</b>	06-10-2015
<b>Number of Attendees</b>	30

(4)

<b>Type of Event</b>	Public or professional presentation
<b>Description</b>	
<b>Event Date</b>	
<b>Number of Attendees</b>	

#### Leveraged Funds

(1)

<b>Purpose</b>	Travel award to Christine Stawitz for conference attendance, American Fisheries Society
<b>Source</b>	NMFS/Sea Grant
<b>Amount</b>	630
<b>Start Date</b>	08-16-2015
<b>End Date</b>	08-20-2015

(2)

<b>Purpose</b>	Travel award to Christine Stawitz to Pacific Fishery Council Meeting to present petrale sole stock assessment
<b>Source</b>	NMFS/Sea Grant
<b>Amount</b>	190.92
<b>Start Date</b>	06-10-2015
<b>End Date</b>	06-11-2015

#### Impacts and Accomplishments

No **Impacts and Accomplishments** information reported