July 2012

Commenter Glen Morgan submitted several e-mails with attached documents, many of which were not printed due to their size. The attachments are available upon request from the Planning Department.

All documents and attachments submitted to the County were forwarded to the Board of County Commissioners for their consideration.

Andrew DeFiobis, Associate Planner
Thurston County Long Range Planning Department
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Cathy Wolfe <WolfeC@co.thurston.wa.us>, Karen Valenzuela <ValenzK@co.thu...
Date: 07/05/2012 4:58 PM
Subject: Public Comment - BAS - CAO - "Natural Background Soil Metals Concentrations in WA State"
Attachments: 94115-Background2[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Natural Background Soil Metals Concentrations in Washington State"

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
Andrew Deffobis - Public Coment CAO - BAS - Contaminants in water, soil, sediment etc

From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
Date: 07/05/2012 4:52 PM
Subject: Public Coment CAO - BAS - Contaminants in water, soil, sediment etc
CC: Karen Valenzuela <ValenzK@co.thurston.wa.us>, Sandra Romero <RomeroS@co....

Andrew,
Here are a few more things. This email focuses on published criteria related to safe/unsafe levels of contaminants in water, soil, sediment. These criteria should be used to evaluate whether there should be any prima facie concern that might require further analysis via risk assessment.

http://www.ecy.wa.gov/programs/tcp/smu/sed_chem.htm
http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/index.cfm#final
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/
http://www.epa.gov/region9/superfund/prg/
http://water.epa.gov/drink/contaminants/index.cfm

Best regards,
Glen Morgan
Project Manager
Stop Taking Our Property (STOP) Thurston County
Andrew,  

I've attached the following document for inclusion in the public testimony for the Thurston County CAO. This is a Property Rights Discussion Paper presented to the PSRC Growth Management Policy Board in July 2012 by the Kitsap Alliance of Property Owners.

While this is written from a Kitsap County perspective, the core issues are relevent in Thurston County as well, and it should be part of the public comment record here as well.

Best regards,

Glen Morgan
Project Manager
Stop Taking Our Property (S.T.O.P.) Thurston County
Andrew Deffobis - Public Comment - BAS - CAO - Fate & Transport Science - mostly. Better model data.

From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
Date: 07/03/2012 2:46 PM
Subject: Public Comment - BAS - CAO - Fate & Transport Science - mostly. Better model data.
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <WolfeC@co.thurston.wa.us>

Andrew,

I am submitting the attached link files and documents as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. I would recommend formally printing and keeping the following three referenced source documents (all linked below - if you need additional hard copies, I can print some for your reference) for BAS purposes:
1. Empirical Models for the Uptake of Inorganic Chemicals from Soil by Plants (particularly sections 1-5)
2. Development and Validation of Bioaccumulation Models for Small Mammals

Please note the other links with thier reference materials should also be submitted as BAS for reference in Thurston County’s public comment portion of the CAO.
http://epa.gov/riskassessment/basicinformation.htm#risk ---- this is the main risk assessment site for EPA

These other sites below are supplementary sites with good info on fate and transport and risk:
http://www.epa.gov/region8/r8risk/models.html
http://elu-in.org/contaminantfocus/default.focus/sec/sediments/cat/Fate_and_Transport_of_Contaminants/
http://www.epa.gov/oswer/riskassessment/policy.htm

These documents and source sites will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482

file://C:\Documents and Settings\deffoba\Local Settings\Temp\XPgrpwise\4FF305D1Thu... 07/06/2012
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <WolfeC@co.thurston...
Date: 07/03/2012 2:30 PM
Subject: Public Comment - CAO - BAS - The Role of Screening Level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments
Attachments: Precautionary_slera0601[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "The Role of Screening-Level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments." EPA publication 934.0-14

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS). Specifically this document refers to fate and transport science issues, which should be understood by Thurston County staff before inventing rules.

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
Andrew,

Attached is a document providing more details related to the problems with the public hearing process. This document is intended to be part of the public record for the Thurston County CAO.

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
Andrew Deffobis - Fwd: Dear Glen Re: Sign in sheets

From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
Date: 06/29/2012 2:19 PM
Subject: Fwd: Dear Glen Re: Sign in sheets
CC: <vickiebrower@yahoo.com>

Andrew,

Please include this in the public record - commentary on the CAO hearing June 23, 2012.

Best regards,

Glen Morgan

---------- Forwarded message ----------
From: vickie Brower <vickiebrower@yahoo.com>
Date: Fri, Jun 29, 2012 at 12:09 PM
Subject: Dear Glen Re: Sign in sheets
To: glen@stopthurstoncounty.com

To whom it may concern,

On January 20th 2011, when I attended that hearing, I was told at the door only sign in if your going to speak. There was not a second sign in for those who attended. I asked how are you going to keep track of the number of people that have come? The man at the door (I didn't get his name) told me "Oh we know", that concerned my very much, when this is suppose to be an official meeting and a very serious matter. At that time I saw a column: for or against on the sign in sheets, but again when I stepped to the table, again I was told "this is only if your going to speak". I did speak and submitted my documents and sent a letter of opposed.

Then the meeting to follow-the column disappeared. Not only that, but we were again told only to sign in if you are going to speak and we were signing on the back of the sheets with nothing printed on them. I and others asked while standing in line, where do you sign if not speaking and the column: for or opposed went? With no answer on the column, so I signed the back of a blank sheet and I wrote in my opposed and I signed to speak.

Again at this hearing (June 23rd, 2012) the column was not put back on (for or against). When I stepped up to the table, I was told to only sign if you want to speak. I asked where is the column: for and against again? I was told that is per the Commissioners decision. When I spoke for the record at the June 23rd hearing. I spoke directly to this missing column, and so did others. I let the Commissioners know on the record, and when I did, Romero shot a look towards her staff that you could tell.. Who said that?

I have been deeply disappointed in the officials rolling their eyes, drinking their water and not listening to the citizen's, businesses, property owners, tribal members, and scientist that spoke and the numbers game. The ratios no matter how they try to look at the numbers or ignore them, all that attended know and even the Olympian news paper had to state "the majority are against the new CAO".

I was not planning to speak again June 23rd 2012 because they do not listen. I was just attending to be counted and with sending a letter of opposed, but after I saw that their sign in sheets are still missing the column. I had to speak to be counted. I spoke Number 58 and as of number 60 there was only 2 for the new CAO's (541 pages of changes not updating) and 1 that will have to reevaluate his decision for or against now that they had more information, just in speakers alone it was 57 against at this point and this was before the lunch break. This tells the majority is opposed and the Commissioners are not following the RCW 3670 A.030 Law, it states what governs this. When you read the RCW it's very obvious they
are doing some of it for protocol and show, but not to the Law-to consult (a-j)... In addition to consultation required under this subsection, the department shall conduct public hearings in the various regions of the state. The department shall consider the public input obtained at such public hearings when adopting the guidelines. They are totally ignoring the public outcry for science, not conducting the hearings per what is required of them -since July 28th 2009.
I know as of public record I first submitted Jan, 17th 2011 Letter of Opposed as a business owner and public (and the Master Builders of Olympia spoke opposed), scientists, Tribe members and many others that attended opposed and had many reasons why this should not continue or become law. These are suppose to be part of the Archives and done per the RCW, yet they ignored the majority then and still are doing so, at least no matter what it's all part of the record.
Sincerely,
Chad and Vickie Brower
C. B. Metal Buildings and C.
Rochester, WA 98579
This letter can be submitted and forward Thank you
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <Wolfec@co.thurston...
Date: 06/23/2012 4:20 AM
Subject: Public Comment - TC CAO - BAS - Groundwater Conditions in Agricultural Areas -
CCWB 2010
Attachments: McCann,LisaGroundwaterConditions[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Groundwater Conditions in Agricultural Areas" CCWB - 2010

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <WolfeC@co.thurst...
Date: 06/23/2012 4:17 AM
Subject: Public Comment - TC CAO - BAS - Protection of Marine Riparian Functions in Puget Sound, WA
Attachments: wdfw00693[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Protection of Marine Riparian Functions in Puget Sound, WA" WSG

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <Wolfec@co.thurst...
Date: 06/23/2012 4:14 AM
Subject: Public Comment - TC CAO - BAS - Risk in a Free Society - Ruckelshaus
Attachments: Ruckelshaus_1984[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Risk in a Free Society" Ruckelshaus

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Symposium, Ecology and the Law" Tarlock.

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482

From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <Wolfec@co.thurston...>
Date: 06/23/2012 4:11 AM
Subject: Public Comment - TC CAO - BAS - Symposium, Ecology and the Law - Tarlock
Attachments: Tarlock_1994[1].pdf
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <WolfeC@co.thurston.wa.us>
Date: 06/23/2012 4:08 AM

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Urban Hydrology for Small Watersheds" or "TR-55". This is not BAS, but is included for reference because it uses quantity rather than quality of water in runoff. A good example of "eco" slight-of-hand. Filed to ensure reference for source material of incorrect data sets.

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Sampling of Plant Species Studied for Phytoremediation" Appendix 6 (excellent reference).

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <WolfeC@co.thurst...
Date: 06/23/2012 4:00 AM
Subject: Public Comment - TC CAO - BAS - Buffering the Buffer
Attachments: ReidHilton1998_windthrow_buffers[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Buffering the Buffer" Leslie Reid and Sue Hilton

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <WolfeC@co.thurston.wa.us>
Date: 06/23/2012 3:57 AM
Subject: Public Comment - TC CAO - BAS - Nitrate Fate and Transport in the Salinas Valley - Lawrence Livermore Nat. Lab - CA GAMA Spec. Study
Attachments: salinas_rpt[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Nitrate Fate and Transport in the Salinas Valley" California GAMA Special Study - LLNL - Moran, et al

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <WolfeC@co.thurston.wa.us>
Date: 06/23/2012 3:53 AM
Subject: Public Comment - TC CAO - BAS - Setting Buffer Sizes for Wetlands - 2008 - McElfish
Attachments: Setting_Buffer_Sizes_for_Wetlands[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Setting Buffer Sizes for Wetlands" 2008 - McElfish, et al.

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <WolfeC@co.thurston...>
Date: 08/23/2012 3:50 AM
Subject: Public Comment - TC CAO - BAS - Phytoremediation and hyperaccumulator plants - 2005 Peer

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Phytoremediation and hyperaccumulator plants" 2005 Peer, et al.

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <Wolfec@co.thurston...
Date: 06/23/2012 3:47 AM
Subject: Public Comment - TC CAO - BAS - Selecting and Using Phytoremediation for Site Cleanup - 2001
Attachments: phytoremprimer[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Brownfields Technology Primer: Selecting and Using Phytoremediation for Site Cleanup" EPA 2001

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <Wolfec@co.thurston.
Date: 06/23/2012 3:43 AM
Subject: Public Comment - TC CAO - BAS - Phytoremediation Resource Guide - EPA
Attachments: phytoresguide[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of
public comment on the proposed Thurston County Critical Area Ordinance.
The document attached is titled "Phytoremediation Resource Guide" EPA

This document will be considered part of the formal record for any future
litigation involving Thurston County and the failure to use Best Available
Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopturstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <Wolfec@co.thurston...
Date: 06/23/2012 3:40 AM
Subject: Public Comment - TC CAO - BAS - Nonpoint Pollution of Surface Waters with Phosphorous and Nitrogen
Attachments: issue3[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Nonpoint Pollution of Surface Waters with Phosphorus and nitrogen" 1998.

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Introduction to Phytoremediation" 2000.

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <Wolfec@co.thurston...
Date: 06/23/2012 3:33 AM
Subject: Public Comment - TC CAO - BAS - Linking soil - and stream-water chemistry based on a riparian flow-concentration integration model - 2009
Attachments: hessd-6-5603-2009-print[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Technical Note: Linking soil - and stream water chemistry based on a riparian flow-concentration integration model - 2009 - Seibert, et al"

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <Wolfec@co.thurston.wa.us>
Date: 06/23/2012 3:29 AM
Attachments: 201106[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Evaluation of Buffer Width on Hydrologic Function, Water Quality, and Ecological Integrity of Wetlands" Minn. Dept of Transportation Feb 2011 (all 182 pages are helpful)

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <WolfeC@co.thurston.wa.us>
Date: 06/23/2012 3:25 AM
Subject: Public Comment - TC CAO - BAS - Water Quality Modeling based on landscape analysis: Importance of riparian hydrology - Grabs 2010
Attachments: FULLTEXT01-1[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Water Quality Modeling based on landscape analysis: Importance of riparian hydrology" Thomas Grabs - 2010

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <Wolfec@co.thurston...
Date: 06/23/2012 3:21 AM
Subject: Public Comment - TC CAO - BAS - Critique of Meyer Paper - Items regarding wetland/drainageway ordinance San Juan County - Kilduff
Attachments: Discussion_Regarding_Proposed_Wetland[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Items Regarding Wetland/Drainageway Ordinance San Juan County" Kilduff (critique of Meyer Paper) - This is educated commentary on a BAS document that is being submitted for the formal record.

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled ""Meta Analysis of Nitrogen Removal in Riparian Buffers" -June 27, 2007 - Mayer, et al

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <Wolfec@co.thurston.wa.us>
Date: 06/23/2012 3:11 AM
Subject: Public Comment - TC CAO - BAS - A review of Vegetated Buffers and a Meta-analysis of their mitigation efficacy in reducing nonpoint source pollution 2010
Attachments: Zhang_etal_2010_JEQ___buffer_effectiveness_for_NPS[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "A review of Vegetated Buffers and a Meta-analysis of Their Mitigation Efficacy in Reducing Nonpoint Source Pollution - 2010 Zhang, et al

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <Wolfec@co.thurston...
Date: 06/23/2012 3:07 AM
Subject: Public Comment - TC CAO - BAS - Phosphorous Retention in Riparian Buffers: Review of Their Efficiency

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Phosphorous Retention in Riparian Buffers: Review of Their Efficiency" 2009 Hoffman, etal.

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <WolfeC@co.thurston.wa.us>
Date: 06/23/2012 3:02 AM
Subject: Public Comment - TC CAO - BAS - "Denitrification potential, Root Biomass, and Organic Matter in Degraded and Restored Urban Riparian Zones

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Denitrification Potential, Root Biomass, and Organic Matter in Degraded and Restored Urban Riparian Zones, Restoration Ecology - Gift, etal

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <Wolfec@co.thurston...
Date: 06/23/2012 2:58 AM
Subject: Public Comment - TC CAO - BAS - Effects of stream restoration on denitrification in an urbanizing watershed - 2008

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Effects of Stream Restoration on Denitrification in an Urbanizing Watershed" 2008 Kaushal, etal

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Karen Valenzuela <ValenzK@co....
Date: 06/23/2012 2:55 AM
Subject: Public Comment - TC CAO - BAS - Nitrogen uptake and denitrification in restored and unrestored streams - Aquatic Sciences 2009
Attachments: Klocker_et_al_2009_Aquatic_Sciences_-_denitrification_in_restored_urban_streams[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Nitrogen uptake and denitrification in restored and unrestored streams in urban Maryland, USA" Aquatic Sciences, 2009, Klocker, etal.

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <defoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <Wolfec@co.thurston.wa.us>
Date: 06/23/2012 2:50 AM
Subject: Public Comment - TC CAO - BAS - Methods for measuring Denitrification: Diverse Approaches to a difficult problem 2006

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Methods for measuring denitrification: diverse approaches to a difficult problem" 2006 A synthesis of Denitrification, Groffman, et al.

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <WolfeC@co.thurston.wa.us>
Date: 06/23/2012 2:47 AM
Subject: Public Comment- TC CAO - BAS - Urban riparian ecology - Groffman 2003
Attachments: Groffman_etal_2003_FEE-down_by_the_river[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Down by the riverside: urban riparian ecology" 2003 - Groffman et al.

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <defoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <Wolfec@co.thurston...
Date: 06/23/2012 2:43 AM
Subject: Public Comment - TC CAO - BAS - Nitrogen Processing within geomorphic structures in urban streams
Attachments: Groffman_et_al_2005_(JNABS)[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Nitrogen processing within geomorphic structures in urban streams" 2005 - Journal N.A. Benthol. Soc.

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <Wolfec@co.thurst...
Date: 06/23/2012 2:39 AM
Subject: Public Comment - TC CAO - BAS - Intro to Featured Collection on Riparian Ecosystems and Buffers

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Introduction to the featured collection on riparian ecosystems and buffers" Journal of the American Water Resources Association 2010

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <defoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <WolfeC@co.thurston.wa.us>
Date: 06/23/2012 2:35 AM
Subject: Public Comment - TC CAO - BAS Longitudinal variability in streamwater chemistry and carbon and nitrogen fluxes - JEM 2010

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Longitudinal variability in streamwater chemistry and carbon and nitrogen fluxes in restored and degraded urban stream networks" Journal of Environmental Monitoring Sivirichi, et al.

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stophurstconcounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <WolfeC@co.thurst...
Date: 06/23/2012 2:31 AM
Subject: Public Comment - TC CAO - BAS - Land use and Climate Variability Amplify Contaminant Pulses - June 2010
Attachments: Kaushal_et_al._2010_Land_Use_and_Climate_Variability_Amplify_Contaminant_Pulses_EOS[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Land Use and Climate Variability Amplify Contaminant Pulses" EOS June 2010

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <WolfeC@co.thurston.wa.us>
Date: 06/23/2012 2:27 AM
Subject: Public Comment - TC CAO - BAS submission - Denitrification in Alluvial Wetlands...
Attachments: Harrison_etal_2011_JEQ_-_denitrification_in_alluvial_wetlands_in_an_urban_landscape[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Denitrification in Alluvial Wetlands in an Urban Landscape" Technical Reports: Wetlands and Aquatic Processes Harrison, etal

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <Wolfec@co.thurston...
Date: 06/23/2012 2:23 AM
Subject: CAO Public Comment - BAS doc submission - Microbial biomass and activity in geomorphic features...

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Microbial biomass and activity in geomorphic features in forested and urban restored and degraded streams" Ecological Engineering Harrison etal

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <Wolfec@co.thurst...
Date: 06/23/2012 1:59 AM
Subject: Public Record TC CAO - BAS doc 2012 Biogeochemistry

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Nitrate removal in two relict oxbow urban wetlands: a 15N mass-balance approach" Biogeochemistry 2012 - Harrison etal

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <Wolfec@co.thurston.wa.us>
Date: 06/23/2012 1:23 AM
Subject: Formal Public Comment on TC CAO - BAS Record Submission
Attachments: Mayer_etal_2010_JEQ---N_dynamics_at_GW_SW_interface[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Nitrogen Dynamics at the Groundwater - Surface Water Interface of a Degraded Urban Stream" Mayer et al...

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <Wolfec@co.thurston...
Date: 06/23/2012 1:14 AM
Subject: Formal Public Comment - Record Submitted for Striz/Mayer 2008 BAS reference

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Assessment of Near-Stream Ground Water-Surface Water Interaction (GSI) of a Degraded Stream before Restoration" Aug. 2008 Striz/Mayer

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Sandra Romero <RomeroS@co.thurston.wa.us>, Cathy Wolfe <Wolfec@co.thurston...
Date: 06/23/2012 1:08 AM
Subject: Formal Public Comment and BAS Lit Review for Riparian Buffers
Attachments: LitReviewRiparianBuffers[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "A review of the Scientific Literature on Riparian Buffer Width, Extent and Vegetation" Please also note the 140 original source articles and books in this review.

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Glen Morgan <glen@stopthurstoncounty.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
CC: Cathy Wolfe <Wolfec@co.thurston.wa.us>, Karen Valenzuela <ValenzK@co.thu...
Date: 06/23/2012 1:02 AM
Subject: Document for Legal Record on Thurston County CAO
Attachments: jpcrd598[1].pdf

Andrew,

I am submitting the attached document as part of the formal record of public comment on the proposed Thurston County Critical Area Ordinance. The document attached is titled "Factors Affecting Sorption of Organic Compounds in Natural Sorbent/Water Systems and Sorption Coefficients for Selected pollutants. A Review"

This document will be considered part of the formal record for any future litigation involving Thurston County and the failure to use Best Available Science (BAS).

Best regards,

Glen Morgan
Project Manager, Stop Taking Our Property (S.T.O.P.) Thurston County
a project of the Freedom Foundation
(360) 956-3482
From: Walter Jorgensen <waltjorgensen@comcast.net>
To: <deffoba@co.thurston.wa.us>
Date: 06/23/2012 8:57 AM
Subject: Thurston County needs a strong CAO

Dear Mr. Deffobis,

Good Morning, Commissioners-

My name is Walt Jorgensen. I live at 823 North St SE in Tumwater and own a house with acreage south of the airport.

Thank you for this opportunity to submit testimony on your proposed CAO Ordinance update. I attended some of the Planning Commission meetings and I much appreciate their work. Also, staff has gone the extra mile with their excellent Myths and Facts Sheet and online videos. I think you should adopt this ordinance after just a little tweaking.

First, I'd like to see you apply the precautionary approach to the Aquifer Recharge Areas. Quality water cannot be compromised.

Clearing and grading protective standards for all riparian areas should be increased.

The 5,000 sq. ft buildable area allowed seems too large.

And rebuilding where we shouldn't have built in the first place, like floodplains, just doesn't make much sense.

As a footnote, let me recall to you that I received an email earlier this week that made several wild assertions about the dire effects of this ordinance and spoke disparagingly about you as elected officials. I choose not to quote directly from the text, but I will submit a copy to you for the record at your request. What I find most troubling about these tactics is that, while we are all entitled to hold opinions no matter how extreme, it becomes a disservice to disguise those opinions as fact and inflict them on other people who are simply looking for the truth.

Thank you.

Walter Jorgensen
823 North St SE
Tumwater, WA 98501
Thank you, the Planning Commission and county staff! Thurston County may now benefit from an improved CAO. I hope there will be a decision to increase both enforcement and use-incentives to facilitate a smooth implementation and compliance with the new regulations.

We are concerned about hardships imposed on property owners due to loss of use. If decades old use patterns are being altered to benefit all citizens of the county, then a few citizens should not be expected bear the burden.

Valerie Hammett and Rob Kirkwood
Andrew Deffobis - Support of Critical Areas Ordinance

From: <judybardin@comcast.net>
To: <deffoba@co.thurston.wa.us>
Date: 06/23/2012 9:37 AM
Subject: Support of Critical Areas Ordinance

Andrew Deffobis:

I am writing to support the proposed 2012 Critical Ordinance Update. I commend the planning staff and the County Commissioners for their outstanding work on this ordinance.

I urge you to adopt the 2012 Draft Ordinance Critical Areas Ordinance with a few improvements.

- The Critical Aquifer Recharge Area should be protected to ensure that the potable water supply remains in pristine conditions for future generations. I have serious concerns about discharging treated water onto land. This may result in contaminants (such as pharmaceuticals) entering the water supply.

- Consider reducing the Non Conforming Use Section to require a smaller footprint than the 5,000 sq. ft build-able land area. In sensitive critical areas, this is a very large amount of construction to be allowed.

- Land clearing practices should be enhanced to limit the amount of destruction that takes place when land is cleared and graded. Every effort should be made to maintain as much existing soil, vegetation, and trees when land is cleared.

Thank you for considering my comments.

Judy Bardin
Judy Bardin
3129 Hoadly St. SE
Olympia, WA 98501-3508
360-352-9564
From: Nancy Partlow <nanpartlow@comcast.net>
To: <deffoba@co.thurston.wa.us>
Date: 06/23/2012 10:05 AM
Subject: Thurston County needs a strong CAO

Dear Mr. Deffobis,

A strong CAO for the County is important for the health of the ecosystem. Thank you for an excellent service in producing a much improved draft Critical Areas Ordinance. I support the following recommendations:
  • Need wide buffers, especially for the marine shorelines. Science tells us that the buffers should be up to 1000 feet wide.
  • Clearing and Grading should be prohibited in all riparian habitat buffers and conditionally allowed in management zones.
  • Shoreline armoring language should promote soft over hard armoring.
  • More use of enforcement, education, incentives (through expansion of the open space tax benefit program) should be included.
  • The wetlands buffers are good and in accordance with Department of Ecology recommendations

Thank you.

Nancy Partlow
1841 Trosper Rd. SW, #13
Tumwater, WA 98512
From: Margaret Rader <m.rader@mac.com>
To: <deffoba@co.thurston.wa.us>
Date: 06/23/2012 10:09 AM
Subject: I support a strong CAO

Dear Mr. Deffobis,

A strong CAO for the County is important for the health of the ecosystem. Thank you for an excellent service in producing a much improved draft Critical Areas Ordinance. As a property owner with affected property, I support the following recommendations:

• Need wide buffers, especially for the marine shorelines. Science tells us that the buffers should be up to 1000 feet wide.
• Clearing and Grading should be prohibited in all riparian habitat buffers and conditionally allowed in management zones.
• Shoreline armoring language should promote soft over hard armoring.
• More use of enforcement, education, incentives (through expansion of the open space tax benefit program) should be included.
• The wetlands buffers are good and in accordance with Department of Ecology recommendations

Thank you.

Margaret Rader
11521 Holm Rd. SW
Rochester, WA 98579
From: The Rev George Boyle <laceyvicar@yahoo.com>
To: "deffoba@co.thurston.wa.us" <deffoba@co.thurston.wa.us>
Date: 06/23/2012 10:17 AM
Subject: CAO

I am writing today to say that I stand in support of the critical area ordinance.

I believe the STOP folks are fanning the flames of fear in our community.

George Anne Boyle

Sent from my iPhone
From: kathleen oconnor <tolumnia@gmail.com>
To: <deffoba@co.thurston.wa.us>
Date: 06/23/2012 10:18 AM
Subject: I Support a strong CAO

Dear Mr. Deffobis,

A strong CAO for the County is important for the health of the ecosystem. Thank you for an excellent service in producing a much improved draft Critical Areas Ordinance. I support the following recommendations:
- Need wide buffers, especially for the marine shorelines. Science tells us that the buffers should be up to 1000 feet wide.
- Clearing and Grading should be prohibited in all riparian habitat buffers and conditionally allowed in management zones.
- Shoreline armoring language should promote soft over hard armoring.
- More use of enforcement, education, incentives (through expansion of the open space tax benefit program) should be included.
- The wetlands buffers are good and in accordance with Department of Ecology recommendations, but would be even more beneficial if larger. Current recommendations are a significant compromise.

* one specific item needing further attention is the 5000 sq ft allowance for SUP development. This is a large area, larger than the average Thurston County home footprint. And this is in an area where protection is needed. I would suggest 2500 footprint.

Finally, protecting critical areas does not automatically devalue a property, in fact it can add to its value - for the individual and the community.

Thank you.
Kathleen O'Connor

kathleen oconnor
thurston county
olympia, WA 98512
From: Jim Park <parkwood6farms@gmail.com>
To: <deffoba@co.thurston.wa.us>
Date: 06/23/2012 10:41 AM
Subject: Comments on CAO Update
Attachments: Thurston County CAO commnets 6-12.docx
Dear Commissioners:

Please consider these comments on the proposed Critical Areas Ordinance (CAO) additions and modifications regarding “Garry Oak” and the “Mazama pocket gopher” (*Thomomus mazama yelmensis* sp.) potential habitat that the County CAOs are attempting to protect.

I am submitting these comments as an environmental management professional, with over 22 years of experience in natural resource management for Local, Tribal, and State governments (including extensive experience with the Endangered Species Act (ESA)).

I am also submitting these comments as an: agricultural producer in Thurston County; a landowner; and taxpayer.

1. **Gophers**—It would appear that Thurston County is tailoring its CAO update to develop a Habitat Conservation Plan (HCP) through the U.S Fish and Wildlife Service (USFWS) for the Mazama pocket gopher (*T. m. yelmensis*). USFWS is providing funding for this effort. This species is a candidate for listing under the Endangered Species Act (ESA). However it is not listed as federally threatened or endangered, for there is insufficient habitat or population data to propose either designation. Developing an HCP is a prolonged, challenging, and expensive process. Because of this, it is extremely unusual to undertake such an effort prior to a formal listing of the species.

2. This species has been a candidate for 11 years. USFWS is starting a “status review” later this year, (meaning that it is unlikely to be listed any time soon). Neither the status, nor timing of any future listing has been determined. It is irrational and wasteful to expend federal, state, or local funding, as well as staff time to develop an HCP until a species is listed and its status (threatened or endangered) has been determined. Little is known about this species and from the research that I have reviewed the population is much larger and utilizes a much more diverse set of habitat conditions than previously thought.

3. **Jurisdictional Fragmentation of Species Range**—Significant portions of the prairie habitat said to be important for the gophers is within Fort Lewis and other parts of JBLM. If there is going to be effective management of this species, it should be coordinated within its entire range or ESU (Evolutionary Significant Unit). Because JBLM is under Federal jurisdiction, no Thurston County regulations apply there. As a result, there is no way to address the entire
range of this species under the proposed regulations because there is no mechanism to develop a uniform approach between the various jurisdictions that overlap its range.

4. Thurston County is jumping the gun before the USFWS has determined that there is a need, and before jurisdiction has been established over the entire range of the candidate species. When JBLM is not included in habitat management plans, the burden falls disproportionately on private citizens due to the fact that a significant portion of the remaining prairie in Thurston County is under Federal jurisdiction. On both scientific and legal grounds, it is improper that private citizens be prevented from building a garage, a home, or keeping animals, when the Army is driving tanks and conducting live fire artillery practice on the same prairie habitat just down the road. Documentation from WDFW supports this assertion, as only “Half of the known gopher populations are on private lands”. (Stinson, D.W.- WDFW 2005). In addition the same report concludes; “Most occupied habitat on public lands is affected by non-conservation uses including military training and recreation.” (ibid)

USFWS has provided funding for Thurston County to develop an HCP to preserve prairie habitat to protect the gopher. It is my opinion that USFWS is hoping to get Thurston County residents to carry the burden of preserving the candidate species so that they do not have to deal with the implications of the military impacts on the same species, in the same habitat. Thurston County land owners should not have to carry the burden for USFWS and the Army.

5. In addition to the jurisdictional problems involving JBLM, significant portions of the gopher’s range extend into Pierce County. Thurston County ordinances of course do not apply there either. Without a federal listing under the ESA, Thurston County’s proposed regulations make no sense---They are proposed before a need is demonstrated by USFWS, and without any authority to manage the candidate species throughout significant portions of its range, which lie outside of Thurston County jurisdiction. According the 2005 WDFW report, “T. m. yelmensis. is found on locations scattered on the remnants of prairie in Pierce and Thurston counties “. (Ibid) Because of the factors outlined above, Thurston County’s proposal is unlikely to be successful in effectively managing this species. This misguided attempt comes at the expense of Thurston County rural landowners, and in the end, the County Commissioners’ and Planning Department Staffs’ credibility.

6. There has been much rhetoric in the form of veiled threats that a federal listing would be more severe, requiring individual consultations from USFWS. This is a falsehood floated as a scare tactic to make citizens afraid of the federal government and thus to accept the foisting of County regulations upon their land. These claims are based on a twisted
interpretation of ESA. In order to trigger ESA, there must be a "Federal Nexus" for the proposed action. This is triggered by need for a Federal involvement. Federal project funding, actions on Federal Land, or the need for a Federal permit, (such as from the Army Corps of Engineers) are the most common triggers for Federal Nexus with the ESA. Most residential and agricultural practices do not require such permits and thus have no Federal Nexus. In reality, The County’s proposal to develop an HCP potentially generates a Federal Nexus for all county permit activities. This is a recipe for disaster. Thurston County lacks the staffing, and most importantly the professional expertise to cope with the complex issues associated with developing and implementing an HCP. Thurston County should not pursue an HCP for the Mazama pocket gopher, and should refrain from issuing any regulations regarding this species until a decision by USFWS determines their status.
From: Jim Park <parkwood6farms@gmail.com>
To: <deffoba@co.thurston.wa.us>
Date: 06/23/2012 11:49 AM
Subject: Comments on Proposed CAO Revisions
Attachments: TC_CAO_comments[1].docx
Dear County Commissioners:

Thank you for the opportunity to comment on the proposed Critical Areas Ordinance.

When we discuss oak habitat, we need to be clear of what is actually mapped and the potential of prairie/oak habitat if protected. A big set-back to any potential goal is that WADNR has not mapped all Garry Oak in the County, thus the stats provided by Thurston County and others are inaccurate as far as oak and prairie habitat lost vs. remaining.

We contacted WADNR in 2006 about our seven plus acres of oak that were not mapped on our property along the Nisqually River. WADNR response to us was to “GPS it and send the data to them for review?” Why should (would?) a property owner do that to be overly regulated when they are trying to do the right thing and the regulatory agencies do not have a basic map of the habitat they have designated as “priority habitat”?

While we have our bias on why we protect, enhance, and restore our oak on our property, the regulatory community should be focused on what they are trying to preserve: Butterflies? Gophers? Western Gray squirrels? Prairie plants/forbs?

We would like to suggest an ecosystem that supports all of the above...unfortunately, that will be difficult to identify via a GIS layer, and the fact the majority of “prairie/oak habitat” was disturbed and developed over the past 100 years...

While Thurston County is designating the majority of the county as “prairie habitat”, based on soils, it does not address what they are trying to protect, except gophers? And they do not provide references to support that recommendation?

There is no focus on oak/prairie ecosystem preservation or restoration in the “new” Thurston County regulations except to put additional burdens on property owners who own one acre of “prairie soils”. What will that accomplish?

As a prairie listserve member recommended in a previous post...and I am paraphrasing,”save the best...create oak/prairie banks...don’t try and regulate parcels that contribute nothing to the oak/prairie ecosystem...” We know where the high quality functioning prairies ecosystems are...let’s save them by buying them.”

Jim Park
16135 Railway Rd.
Yelm, WA
From: David Heywood <d.heywood@comcast.net>
To: <deffoba@co.thurston.wa.us>
Date: 06/23/2012 11:06 AM
Subject: CAO

Hello:

I just want the commissioners to know that I support the new Thurston County Critical Areas Ordinance.

Sincerely,

Dave Heywood
1208 Arcadia St. NW
Olympia, WA
98502
Andrew Deffobis - I support CAO update

From:  "Barb Scavezze" <barb@scavezze.com>
To:    <deffoba@co.thurston.wa.us>
Date:  06/23/2012 11:11 AM
Subject: I support CAO update

Andrew,

I support the update to the Thurston County Critical Areas Ordinance (CAO), to protect our natural resources in Thurston County. I appreciate and support the efforts of the BOCC and the Planning Commission in updating the CAO.

Barbara Scavezze
3008 Amhurst Ct SE
Olympia, WA 98501
360-878-9901
From: Doug Bonner <olddog4041@yahoo.com>
To: "deffoba@co.thurston.wa.us" <deffoba@co.thurston.wa.us>
Date: 06/23/2012 11:20 AM
Subject: Thurston County Draft CAO Comment Letter

Douglas P. Bonner
4041 Sleater Kinney Rd. NE
Olympia, WA 98506

June 23, 2012

Andrew Deffobis, Associate Planner
Thurston County Planning Department,
2000 Lakeridge Drive SW,
Olympia, WA 98502.

Dear Mr. Deffobis:

I wish to go on record as opposing the Draft Critical Area Ordinance being proposed by Thurston County.

I support the positions taken by the Olympia Master Builders and the Thurston County Farm Bureau. Both organizations have taken the time and expended the funds necessary to make sound and complete arguments against the proposed Critical Area Ordinance rewriting.

As a property owner and steward of my land I feel the proposed wetland buffers are excessive and lack a basis in good science. Currently approximately 40% of my land is classified as Wetland and Wetland Buffer. Should the wetland buffers be extended as proposed I stand the possibility of losing up to 40% of the remaining useable area of my property. This is a taking that will dramatically affect the well being of my family.

Please consider the recommendations and changes proposed by the Olympia Master Builders and the Thurston County Farm Bureau.

Sincerely,

Douglas P. Bonner.
From: "Ed Danzer" <ed@dehyds.com>
To: <deffoba@co.thurston.wa.us>
Date: 06/23/2012 11:29 AM
Subject: Critical Areas Ordinance update

As a life time resident, property owner, small business owner and an employee of a small business in rural Thurston County I have great concerns with the Critical Areas Ordinance update.

If I understand the Ordinance provisions, my residence, job and small business will be eliminated or greatly encumbered.

There are no provisions in the Ordinance for financial damages for existing land owner, business owners or employees when enforcement of the Ordinance is done, just fines for non compliance.

I understand that protecting the environment is important but a person’s Constitutional rights were created first and are more important as many people have died protecting them. The correct way to protect the environment and the Constitution is to provide monetary relief to those affected. This will require adding a section for monetary compensation when the Ordinance changes the use and or availability for use of property.

Section 24.02.050B states that legal and economic issues have been considered but there are no provisions that show these issues have been considered.

At this time I think it would be in the best interest of Thurston County officials and employees to consider how to make a sustainable economy and protect property rights if you do not want the next financial disaster to unfold. In a sustainable economy each person must produce more than they consume and consume what they produce or produce items others need for a good standard of living.

If you have questions or would like to discuss this more call me between 8:00 AM and 5:00 PM at 360-264-2141.

Best Regards,

Ed Danzer
Owner
Phone 360-264-2141
Sent from my iPhone

Begin forwarded message:

From: "tcbocc" <tcbocc@co.thurston.wa.us>
Date: June 23, 2012 11:27:24 AM PDT
To: "Robin Courts" <Courtsr@co.thurston.wa.us>, "Donald Krupp" <Kruppd@co.thurston.wa.us>, "Vickie Larkin" <LarkinV@co.thurston.wa.us>, "Becca Pilcher" <pilcher@co.thurston.wa.us>, "Sandra, ThurstonCo. Commissioner Romero" <RomeroS@co.thurston.wa.us>, "Karen Valenzuela, Thurston Co. Commissioner" <ValenzK@co.thurston.wa.us>, "Danielle Westbrook" <Westbda@co.thurston.wa.us>, "Cathy Wolfe, Thurston Co. Commissioner" <WolfeC@co.thurston.wa.us>
Subject: Fwd: Critical Area Ordance update

"""
<webserver@co.thurston.wa.us> 06/23/2012
11:27 AM >>>

***************

Please note the following: This e-mail message was generated using the Thurston County E-mail Web Application. The 'Sender Email' address in the message body is as entered by the user and may not be valid. The 'From' e-mail address in the message header cannot be replied to.

***************

Subject: Critical Area Ordance update

Sender Name: Ed Danzer

Sender Email: ed@danzcoinc.com

Sender Message: As a life time resident, property owner, small business owner and an employee of a small business in rural Thurston County I have great concerns with the Critical Areas Ordinance update. If I understand the Ordinance provisions, my residence, job and small business will be eliminated or greatly encumbered. There are no provisions in the Ordinance for financial damages for existing land owner, business owners or employees when enforcement of the Ordinance is done, just fines for non compliance. I understand that protecting the environment is important but a person’s Constitutional rights were created first and are more important as many people have died protecting them. The correct way to
protect the environment and the Constitution is to provide monetary relief to those affected. This will require adding a section for monetary compensation when the Ordinance changes the use and or availability for use of property. Section 24.02.050B states that legal and economic issues have been considered but there are no provisions that show these issues have been considered. At this time I think it would be in the best interest of Thurston County officials and employees to consider how to make a sustainable economy and protect property rights if you do not want the next financial disaster to unfold. In a sustainable economy each person must produce more than they consume and consume what they produce or produce items others need for a good standard of living. If you have questions or would like to discuss this more call me between 8:00 AM and 5:00 PM at 360-264-2141.

Best regard, Ed Danzer

<Mime.822>
To: <webserver@co.thurston.wa.us>

Date: 6/23/2012 11:27 AM

Subject: Critical Area Ordinance update

**************

Please note the following: This e-mail message was generated using the Thurston County E-mail Web Application. The 'Sender Email' address in the message body is as entered by the user and may not be valid. The 'From' e-mail address in the message header cannot be replied to.

**************

Subject: Critical Area Ordinance update

Sender Name: Ed Danzer

Sender Email: ed@danzcoinc.com


Sender Message: As a life time resident, property owner, small business owner and an employee of a small business in rural Thurston County I have great concerns with the Critical Areas Ordinance update. If I understand the Ordinance provisions, my residence, job and small business will be eliminated or greatly encumbered. There are no provisions in the Ordinance for financial damages for existing land owner, business owners or employees when enforcement of the Ordinance is done, just fines for non compliance. I understand that protecting the environment is important but a personâ€™s Constitutional rights were created first and are more important as many people have died protecting them. The correct way to protect the environment and the Constitution is to provide monetary relief to those affected. This will require adding a section for monetary compensation when the Ordinance changes the use and or availability for use of property. Section 24.02.0508 states that legal and economic issues have been considered but there are no provisions that show these issues have been considered. At this time I think it would be in the best interest of Thurston County officials and employees to consider how to make a sustainable economy and protect property rights if you
do not want the next financial disaster to unfold. In a sustainable economy each person must produce more than they consume and consume what they produce or produce items others need for a good standard of living. If you have questions or would like to discuss this more call me between 8:00 AM and 5:00 PM at 360-264-2141. Best regard, Ed Danzer
Andrew Deffobis - I support CAO update

From: Dan Scavezze <dan@scavezze.com>
To: <deffoba@co.thurston.wa.us>
Date: 06/23/2012 11:35 AM
Subject: I support CAO update

Andrew,

I support the update to the Thurston County Critical Areas Ordinance (CAO), to protect our natural resources in Thurston County.

Dan Scavezze
3008 Amhurst Ct SE
Olympia, WA 98501
360-878-9901
From: "Annie McManus/Hugh O'Neill" <baseballmonkey@q.com>
To: <deffoba@co.thurston.wa.us>
Date: 06/23/2012 12:05 PM
Subject: CAO comments

Dear County CAO Staff:

Thank you Planning Commission and County staff for producing a much improved 2012 Draft CAO. Please adopt the 2012 Draft Critical Areas Ordinance with some improvements.

The CAO could be improved by increasing protective standards for Clearing and Grading in all riparian habitat buffers and riparian management zones. The wetlands buffers are good and in accordance with Department of Ecology recommendations.

The marine and freshwater buffer widths are good policy compromises that are supported by Best Available Science information. However, they are policy compromises and this level of protection will still result in cumulative effects to our water quality. The County should, therefore, mitigate and enhance in other areas to assure against further degradation. Mitigation could include both strengthening landscape-scale protections for ecosystem function when updating the Comprehensive Plan, and/or encouraging landowners via incentives to become better stewards.

Please consider changing the Non Conforming Use Section to require a smaller footprint than the 5,000 sq. ft buildable area. The 5,000 sq. ft proposal is not based on science and allows for encroachment into the riparian area. Other jurisdictions do not allow for such a large area.

Reasonable Use Exemptions should not allow rebuilding in floodplains, and freshwater or marine riparian and wetland buffer areas if a home is completely damaged by a natural disaster. Best Available Science guidance recommends rebuilding outside the riparian area.

The County should apply the precautionary approach (first, do no harm) in all cases to our Critical Aquifer Recharge Areas to ensure that our primary sources of water maintain their high quality.

Please increase both enforcement and use-incentives to facilitate a smooth implementation and compliance with the new regulations.

Thank you for your efforts. Best wishes,

Hugh O'Neill
From: Annie McManus <anniemcmanus21@gmail.com>
To: <deffoba@co.thurston.wa.us>
Date: 06/23/2012 12:29 PM
Subject: CAO Comments

Dear CAO Staff:

I am very appreciative that there is continued effort to PASS the Critical Areas Ordinance. Please adopt the 2012 Draft Critical Areas Ordinance with some improvements.

Please increase protective standards for Clearing and Grading in all riparian habitat buffers and riparian management zones.

The marine and freshwater buffer widths are good policy compromises that are supported by Best Available Science information. However, they are policy compromises and this level of protection will still result in cumulative effects to our water quality. The County should, therefore, mitigate and enhance in other areas to assure against further degradation. Mitigation could include both strengthening landscape-scale protections for ecosystem function when updating the Comprehensive Plan, and/or encouraging landowners via incentives to become better stewards.

Please consider changing the Non Conforming Use Section to require a smaller footprint than the 5,000 sq. ft buildable area. The 5,000 sq. ft proposal is not based on science and allows for encroachment into the riparian area. Other jurisdictions do not allow for such a large area.

Reasonable Use Exemptions should not allow rebuilding in floodplains, and freshwater or marine riparian and wetland buffer areas if a home is completely damaged by a natural disaster. Best Available Science guidance recommends rebuilding outside the riparian area.

The County should apply the precautionary approach (first, do no harm) in all cases to our Critical Aquifer Recharge Areas to ensure that our primary sources of water maintain their high quality.

Please increase both enforcement and use-incentives to facilitate a smooth implementation and compliance with the new regulations.

With Appreciation for your time and effort,

Annie McManus

Olympia, WA
Andrew Deffobis - Re: CAO update

From: Brian Stafki <brianstafki75@gmail.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
Date: 06/23/2012 12:54 PM
Subject: Re: CAO update

Thank you. We came to the hearing this morning. I was so disappointed by the negative comments and open disrespect for our commissioners. It takes a lot of courage to take leadership in this situation.

I have more some more comments to share:

I moved to WA state in my late 20's. I moved here because there are wetlands, wildlife, and an economy that sees the benefit of the countless environmental services offered by wetlands.

I grew up in the desert. It baffles me that so many people can take for granted something many other parts of the country do not have. It makes them think that every "2 foot wide trickle" of a stream is superfluous. All these streams and the land adjacent are critical to the way of life that many of take for granted.

It is unfortunate that this land that so many people claim ownership over is considered as only economic benefit. That the land they appreciate for its rural character is of value to some future developer. It doesn't seem to matter to them how the future land is treated.

We must remember that this land is the land of all. Please raise my taxes if it means that rural people receive some money that they lose. I consider that money investment in our greater economy. Less money we have to spend on sewage treatment. Less closers of shellfish beds. Less money we have to spend on bridges and culverts washed out from excessive flooding.

I value an ecosystem that is intact. It teaches me and my children humility. It helps me understand we are part of something greater. It provides valuable ecosystem services.

As populations increase, we will continue to make hard decisions that don't seem to be in favor of the individual. We all will have to make room for the needs of the many--including other species.

I encourage you to use all the best available science in your decision making. Thank you for balancing all our needs.

Sincerely, Brian Stafki

On Tue, Jun 19, 2012 at 10:52 AM, Andrew Deffobis <deffoba@co.thurston.wa.us> wrote:

Mr. Stafki,
Thank you for taking the time to comment. Your comments will be forwarded to the Board of County Commissioners for their consideration.
Sincerely,
Andrew Deffobis
Associate Planner
Thurston County Planning Department
2000 Lakeridge Drive SW
Olympia, WA 98502
>>> Brian Stafki <brianstafki75@gmail.com> 06/19/2012 8:57 AM >>>
Thank you Planning Commission and County staff for your excellent service in producing a much improved 2012 Draft CAO!

I urge the Commissioners to adopt the 2012 Draft Critical Areas Ordinance with some improvements.

The CAO will help ensure a healthy environment, which is the cornerstone of our own health and well-being, and high quality of life.

The CAO could be improved by increasing protective standards for Clearing and Grading in all riparian habitat buffers and riparian management zones.

The wetlands buffers are good and in accordance with Department of Ecology recommendations.

The marine and freshwater buffer widths are good policy compromises that are supported by Best Available Science information. And they are policy compromises. This level of protection will still result in cumulative effects to our water quality. The County should, therefore, mitigate and enhance in other areas to assure against further degradation.

Mitigation could include both strengthening landscape-scale protections for ecosystem function when updating the Comprehensive Plan, and/or encouraging landowners via incentives to become better stewards.

Please consider changing the Non Conforming Use Section to require a smaller footprint than the 5,000 sq. ft buildable area. The 5,000 sq. ft proposal is not based on science and allows for encroachment into the riparian area. Other jurisdictions do not allow for such a large area.

Reasonable Use Exemptions should not allow rebuilding in floodplains, and freshwater or marine riparian and wetland buffer areas if a home is completely damaged by a natural disaster. Best Available Science guidance recommends rebuilding outside the riparian area.

The County should apply the precautionary approach (first, do no harm) in all cases to our Critical Aquifer Recharge Areas to ensure that our primary sources of water maintain their high quality.

Increase both enforcement and use-incentives to facilitate a smooth implementation and compliance with the new regulations.

I want my children to be able to have a high quality of life that respects the needs of wildlife and the environment.

Sincerely, Brian
3117 Moore St, SE
Olympia, WA

--
Brian Stafki, M.Ed.
blog: www.leavenworthfoodforest.wordpress.com
www.qnhn.wordpress.com
360-441-2973
Brian Stafki, M.Ed.
blog: www.leavenworthfoodforest.wordpress.com
www.qnhn.wordpress.com
360-441-2973
From: Larry Leveen <larryleveen@comcast.net>
To: <deffoba@co.thurston.wa.us>
Date: 06/23/2012 12:55 PM
Subject: Thurston CAO comment

Dear Commissioners:

I am unable to attend the public hearing on the proposed CAO, but wanted to submit my comment on it for the record.

Please adopt the draft CAO, with the following alterations:

- Protective standards for clearing and grading in riparian areas (habitat buffers and management zones) should be strengthened.

- Mitigation for marine and freshwater impacts should include enhanced landscape-scale protections in the Comprehensive Plan. Additionally incentives for good landowner stewardship should be considered.

- Non-conforming uses should restrict footprints to much smaller sizes when encroaching in riparian areas.

- Reasonable Use Exceptions should NOT include rebuilding in food plains or in riparian areas following destruction of a building.

- Provide utmost protection of Critical Aquifer Recharge Areas, lest we impact our drinking water supply. Others use the "Precautionary Approach" to describe this, and I agree strongly.

Thank you for your time, and congratulations to staff and advisors on on a pretty solid draft of the CAO.

Larry Leveen

OlyBikes
124 State Avenue NE
Olympia, WA 98502
360-753-7525
www.olybikes.com
Attached are my comments on the 2012 draft CAO.

Dave Peeler
June 23, 2012

TO: Thurston County Commissioners

FROM: Dave Peeler

6437 54th Ave NW, Olympia WA 98502

Subject: Draft 2012 Critical Areas Ordinance

I live on 4 acres in the rural northwest part of Thurston County. My land has a freshwater stream, a marine bluff, and forested areas. As a property owner, taxpayer and citizen of Thurston County, I urge you to adopt the 2012 Draft Critical Areas Ordinance (CAO). After several years of excellent work by the Planning Commission and the county staff, the draft CAO is much improved and will provide a solid basis for protecting our critical areas and human health and welfare.

1. The CAO will help ensure a healthy environment, which is the cornerstone of our own health and well-being, and high quality of life. Given the rapid expansion of our population and the associated conversion of our critical areas to other uses, we must protect the remaining areas before they are gone, along with our fish and wildlife, water quality, and way of life.

2. The CAO could be improved by increasing protective standards for Clearing and Grading in all riparian habitat buffers and riparian management zones.

3. The wetlands buffers are good and in accordance with Department of Ecology recommendations and Best Available Science. Wetlands are key resources for fish and wildlife, flood prevention, and water quality.

4. The marine and freshwater buffer widths are good policy compromises that are supported by Best Available Science information. However, to some extent they are policy compromises and this level of protection will still result in cumulative effects to our water quality. The County should therefore mitigate and enhance in other areas to prevent further degradation. Mitigation could include both strengthening landscape-scale protections for ecosystem function when updating the Comprehensive Plan, and/or encouraging landowners via incentives to become better stewards.

5. Please consider changing the Non Conforming Use Section to require a smaller footprint than the proposed 5,000 sq. ft buildable area. The 5,000 sq. ft proposal is not based on science and allows for encroachment into the riparian area. Other jurisdictions do not allow for such a large area.
6. Reasonable Use Exemptions should not allow rebuilding in floodplains, and freshwater or marine riparian and wetland buffer areas if a structure is completely damaged by a natural disaster. Best Available Science guidance recommends rebuilding outside the riparian area.

7. The County should apply the precautionary approach (first, do no harm) in all cases to our Critical Aquifer Recharge Areas to ensure that our primary sources of water maintain their high quality. Citizens in our county rely almost exclusively on ground water for our domestic, industrial and irrigation water supplies. Preventing pollution of our ground water is far less expensive and preferable to cleaning up pollution after it has already happened.

8. Increase both enforcement and incentives to facilitate a smooth implementation and compliance with the new regulations.

The County is well within the law, including state and federal requirements and constitutions, in adopting the CAO. The County and state have many programs to help land owners, developers, farmers and others comply with its requirements. Although you will hear extreme tales of “horror stories” of predicted adverse affects on county residents, you will not be provided with any facts to back them up because they don’t exist. The County has provisions in the CAO, comprehensive plan, and shorelines master program to address situations of undue hardship, as required by state laws. The county and state also have programs to help people comply with the law when funding may be tight. Examples include grants and low interest loans for septic system repairs and replacement or hooking up to sewer systems, financial assistance programs for retaining riparian areas in native vegetation, and others.

I for one am glad the county adopted the initial CAO rules twenty years ago because they ensure that my house is safer to occupy. But the old rules are out of date and must be revised. The new format of the CAO rules is sensible and easier to understand and apply.

While voluntary approaches with incentives are preferred by many people, the truth is they don’t work as a standalone effort. It is well known and proven that a blend of regulations, education, technical assistance, financial assistance, and compliance efforts are needed to assure protection of natural resources. This is because only a small number, about 10 to 20% of people, will voluntarily do the right thing due to education. Some additional number may undertake some aspects, but not enough to make a difference, and some of their efforts will be done wrongly. With regulations, the vast majority of people will comply to the best of their ability. Unfortunately, there will always be a small number who will intentionally violate the requirements, and this is where compliance efforts must be used.
Some people will also argue that the County should purchase the lands that cannot be developed to the use some people would make of them. Although the County is under no legal obligation to do so, this might be a viable alternative if the County taxpayers were willing to tax themselves to fund such a program – but I am unaware of any county in the nation that has done so, let alone here. This approach would be doomed to failure.

The truth is, we must protect our critical areas if we are to leave a functioning, healthy ecosystem in place for future generations. That ecosystem is the foundation of our current prosperity and will provide for many generations to come if properly cared for. Please adopt the draft CAO in order to ensure a healthy and prosperous future for our children and their children yet to come.
Andrew Deffobis - critical areas

From: Joe Hiss <joe.hiss.biologist@gmail.com>
To: <deffoba@co.thurston.wa.us>
Date: 06/23/2012 1:24 PM
Subject: critical areas

Dear Mr. Deffobis,

I am glad the permit has come up for public review and approval. I support it with no reservations. As an environmental educator I am well aware of the need for this update, and my review leads me to believe it should be approved as it stands.

--

Joe Hiss
Hi, Andrew Deffobis,

Please see the attached letter I have written to Commissioner Wolf. I would appreciate a response.

Thank you.

Bruce Ensign
2424 36th Ave NE
Olympia WA 98506
I write in opposition to the proposed Thurston County Critical Area Ordinance (CAO) you are considering. I attended the hearing today, June 23, 2012, but could not stay until you called my number (98). I was born in Olympia Washington and lived at least part of my life where the existing St. Peter’s Hospital resides – on the road named for my family (Ensign). My wife is an official “Thurstoneer”, being a descendant of the Ames Family which has several roads named after them as well, (Ames Road, Baker Ames Road, Ames-Huntley Road). These families have a long history in this area and many of us do own some land. We have complied with countless regulations. We have paid the taxes on the land that allows you and the Thurston County staff to get paid. These families fought hard to preserve their heritage and land, as well as helped establish the culture and prosperity Olympia enjoys. We love the area and have chosen to invest our lives making this a great place to live and work.

The need for this invasive and hostile land grab is not clear and seems to violate our constitutional right to own and use our property as we deem appropriate. Additionally, there is no need to term people’s homes and property as non-compliant just because you have decided to change the rules. A designation of ‘non-compliance’ has several significant implications for people. Not only is it insulting to tell people who have complied with State laws, and County regulations their homes are ‘non-compliant’ because you decide the change the rules, this gives government a bad name. It will build the average citizen’s anger and distrust in government. Furthermore, when you make decisions to enable employees to spend years and years of paid time (paid for by the same taxpayers you are working against in this CAO), to pursue ridiculously restrictive new regulations and then require private individuals to fund or perform their own research, spend countless hours getting organized, and testifying on their own time – it becomes outrageous and embarrassing to be a citizen in this county under your “leadership”. It hardly seems fair. Especially for those who also work for a living and invest their time, talent, and treasure into this county and community.

There is no conclusive evidence that any of the existing set asides or regulations already established are failing and therefore need to be increased. There is no substantive evidence that the county needs to be concerned with a collection of water larger than 1,000 feet in size. There is no substantive evidence the animals dying off (if they are) are not doing so in response to a natural increase of predators such as eagles, coyotes, bears, or diseases. Also, based on testimony given today, the existing rules already work for people to ward off the expansion of the City of Tacoma’s port into southern Thurston County and also protect existing homes on waterfront. There is therefore no need to go to the lengths your CAO describes. Testimony heard today in your hearing room gave evidence that just the proposed CAO has already damaged people’s financial future and stability through drastically reduced land values.

The science is not sound, more regulations are not required, and you are enraging the citizenry by pursuing this CAO. Please stop now before we all end up spending so much more on something that isn’t worth it. The courts are already crowded. I don’t want the CAO to be adopted, approved, or considered any further. As the person you are to represent, I say dump it before it brings us into expensive and distracting lawsuits about it’s constitutionality.

Bruce Ensign, 2424 36th Ave NE, Olympia WA 98506
From: hhaslinger <hhaslinger@earthlink.net>
To: <deffoba@co.thurston.wa.us>
Date: 06/23/2012 3:54 PM
Subject: Testimony for June 23rd Public Hearing

To all concerned,

The proposed Critical Areas Ordinance will typically increase all wetland buffers to a minimum of 100 feet aside from very small ones. This is driven by the water quality section. Today I rated a 2 acre partially forested, partially agricultural wetland and in the current regulations, it would be rated as a Category III wetland with a 50 foot buffer. In the new regulations, it still is a Category III wetland but it would have a 120 foot buffer based on the habitat score. This will significantly reduce property owners available uses on their land and cost more to land owners to apply for variances and reasonable use exceptions which are very expensive. Your fact sheet mentions that the county incorporates mechanisms for landowners to make reasonable use of their property, but that process is unreasonably expensive.

Heidi Haslinger, B.A.Sc.
Wetland Specialist
Pacific Willow Consulting, Inc.
Andrew Deffobis - Critical Area Ordinance

From: "LINDA BERG" <ljbcdg00@msn.com>
To: <deffoba@co.thurston.wa.us>
Date: 06/23/2012 5:40 PM
Subject: Critical Area Ordinance

After receiving your email on JUNE 22, 2012 (5:15 pm) I felt my response has a lot of merit to it. Concerning your wetland, fish, and critical areas. It has been a long standing permit issuance require much. My first concern is why open pit mining is allowed in South Thurston County? Specifically the Grand Mound - Rochester - Tenino areas. I supposed that is what you`d call it, as there is no reclamation of properties only leaving open water areas where the "gravel pits" operate. This changes the quality of our ground water by many many factors. I can think of 8 or 10 of them right off the top of my head. In fact it is against State and Federal laws to of the quality of water changes. The permits here have been given out for years without any regard to the AQUIFER. Lordy be.

PLEASE PLEASE look out for these holes in the system. Enough said on that point.

Next is the critical area off Township Road (183 road )also in the Southern Thurston County. This also needs "a lot" of at attention that is under your control. Again this is to address the WA. State Wildlife area of Scatter Creek.
Off 183rd and Case Road there is no buffer zone to Scatter Creek for riparian rights at all. While the private land owners have such the "game farm" which it is known by has none. The hunting done of this said property is so outlandish it is a public joke. Trees specially protected like the Oak, are being shot with any protection.
There are two areas of wetlands on the southern side located in the middle that qualify under wetlands regulations. Along areas off Case Road this area located right next to Scatter Creek as mentioned before under the riparian regulations.
There are regulations on the use of steel shot near rivers, creeks, and wetlands. This is not in practice. People hunting these areas use mostly lead shot and you can hunt up to the water and even across Scatter Creek if you dare go there.
Speaking of the water quality on said properties near and down stream of Scatter Creek, the laws and regulations are to look out for the health of our wells.
I suppose this is one reason the Mazama Pocket Gopher laws went into effect from the studies done on the prairie lands contaminated not only with YEARS and YEARS of lead shot but the extreme residue left from shells and gun powder aloud to lay on the ground. Year after year it seeps into the ground.
For the fish in Scatter Creek you can imagine only their demise. The riparian regulations that changed a few years back, the salmon were to be protected. Talking to any old timer there never has been salmon in scatter as verified by WFAW there have been no salmon there in about 100 years. There are however many trout.

Do you see my concerns ???
These are Critical Areas you were looking for.....
Many are just breaking the law by not abiding to the regulations.

I am sorry I could not make it to the meeting only receiving the notice 6/22/2012

I thank you for your time.
Charles Good- Rochester, Grand Mound area.
From: Mercy Need <mercyneed@gmail.com>
To: <deffoba@co.thurston.wa.us>
Date: 06/23/2012 6:57 PM
Subject: More thoughts -
Attachments: morecomments.docx

Please see the attached comments regarding the CAO and the public hearing.
I am against adopting the revisions.
I would appreciate a response.
Thank you, Susan Ensign
June 23, 2012

Commissioner Wolf,

After today’s hearing I had a couple of further thoughts I want to express.

No clear objective

I did not hear one comment today expressing concern current land laws were insufficient, didn’t go far enough to adequately protect property, or that more restrictions would be of great benefit. People who were not “against” the proposed new laws did not state why more restrictions seemed important, let alone necessary, but on the contrary indicated how current law was working for their needs just fine. Nor was any evidence presented which justified why such drastic land restrictions would be clearly and directly beneficial to any threatened species with the likelihood of preventing onerous EPA regulations. *Not one piece of testimony stated what the benefits stricter regulations had.* No one talked about why we needed or wanted more land restrictions. Please publically communicate why you feel restrictions are a good thing.

Extreme sacrifices for extreme risks of no return

It seems extremely reasonable for those of us being asked to sacrifice so much to know why we must sacrifice so much! Thurston County has already experienced shocking devaluations in property. (My property was devalued over $75,000 just this year, likely due to pending restrictive land laws.) So I feel we have a right to know why we’re being forced to make such shocking sacrifices. At the very least we should know what the various threatened species population numbers should be, and how were those numbers arrived at. Who gets to decide that? Who pays for the study? When will land rights be restored? If there is no plan for restoring rights, why not? While being wise and prudent about land use stewardship is good, extreme land restrictions to create warm fuzzy feelings about being environmentally superior is not a luxury everyone should be forced to accept. We need good science, sound logic and solid justification for managing
our resources, not just a subjective wish list dictated by whatever feels right to the local authorities at the time.

**Is it really all about the endangered species list?**

Basically the county is forcing land owners to make major sacrifices, and asking them to trust outdated, unsupported, and uncorroborated research done by government employees (who apparently do not have advanced degrees) to *maybe* avoid an endangered species listing. County officials are taking a great risk in reducing the residents land rights. What if the land restrictions do not help the threatened species and they still get listed as endangered? What if natural causes such as disease etc., decrease the numbers of these threatened animals? (Who’s keeping track and how are they funded? How many independent studies will be conducted? When do we get to know the numbers?) If could be very easy to argue that county officials prematurely reduced landowners rights, imposing overzealous, overextended laws, without just or reasonable cause. *There has never been any convincing connection between the specifics of how the proposed land restrictions will directly help with the four threatened species habitat preservation.* Landowners are forced to prematurely sacrifice the use of their land and value for a vague, elusive and undefined goal. This is a giant risk county official’s do not have the right to take and it is gamble at best. Additionally, as was mentioned at the public hearing, some are questioning the constitutionality of what amounts to a land take-over by government. How do you respond to this?

**Making landowners the bad guys**

Additionally, while buffer zones for existing large wetlands were given some attention, the expansion restrictions to include very small ponds and wetlands were not discussed much. This one restriction alone could make a great percentage of residents fall into the negatively termed “non-compliant” category. Again, that sounds like the county wants to bully people into “compliance” and subtly suggests “non-compliant” properties are nearly “illegal”. I’m predicting some will take this as an insult. Please explain. What is the estimated increased
in numbers of ponds/wetlands that will be impacted by the new restrictions, and where are they located? What was the justification and where is the research data to back up including just about any large puddle? How will you inform property owners of the new restrictions; will you be sending out the maps? How many properties are likely to become “non-compliant”? Have you talked with the Insurance Commissioner regarding the designation of “non-compliant” and can you absolutely assure residents being “non-compliant” will not cause them to lose their insurance?

Obviously there remains a great deal of unanswered questions and sense of betrayal in what is really going on with these restrictions. The county has done a miserable job in serving the public with clear, honest leadership regarding land use laws and I still do not understand why they are truly necessary. Do the right thing: the CAO has been reviewed, but new revisions are not at all ready to be implemented at this time.

I do want to thank you for your service. I know people are working very hard; it’d just be better if they were working smarter.

Susan Ensign
From: Mercy Need <mercyneed@gmail.com>
To: <deffoba@co.thurston.wa.us>
Date: 06/22/2012 10:24 PM
Subject: Comments
Attachments: mystatement.docx

Andrew Deffobis,
Please see the attached letter I have written to Commissioner Wolf. I would appreciate a response. I do hope to speak at the public meeting tomorrow.
Thanks,
Susan
June 2012

Commissioner Wolf:

I am writing to express my concerns with the proposed restrictive land use laws. I have checked the county web site and read the threatened and endangered status report summery which I presume addresses the major reason for the drastic reductions on property owner’s rights and expensive new permit fees. I think it is extremely important to be fair and open with the public about all the options and variables under consideration for what is being proposed. Please help me understand better about why Thurston County residents are asked to make such great sacrifices with their land rights and how these sacrifices can be equitably shared by all residents, not those who happen to fall into new restrictive areas. I have several questions which I hope will be answered by you or the other leaders at the public meeting Saturday June 23, 2012.

Will changes be helpful?

In consideration of the power this study will have to wield public opinion, and it’s far reaching implications, the public deserves a standard of the utmost reliable, unbiased, well collaborated, and thoroughly researched project available. Please inform me of why you trust this one study and why the public should trust their land to it because the specifics and data used will be dictating massive restrictions and very likely, severe harmful economic hardship for a large percentage of Thurston County residents. Please explain why several other independent studies should not be considered in formulating such drastic land restrictions. The public has a right to full disclosure; we want helpful change, so convince me why these changes might be helpful and how you plan to monitor the changes to show success or failure.

Gophers & Golfers and animals that Fly

How has a healthy population number been determined for these threatened species? How was the study funded? What measurable objectives were involved? From the WDFW website, the study summery page does not mention several important fundamental facts. What were the actual numbers of healthy populations of these species, and what are they today, last year, and the past 5 to 10 years? Why were so many of the conclusions drawn from “estimates”, mere guesses and not hard numbers? The summery suggests one of its presumptions, (there were many) is based on a comment made by a golfer in 1900 (who apparently spent a great deal of time counting bird nests in tress as opposed to golfing). According to the summary: “There is little information on historical populations. Streaked horned larks were reported to be a “very abundant summer resident of the gravelly prairies near Fort Steilacoom” in the 1850s (Suckley and Cooper 1860). Bowles (1900) estimated that “fully one hundred pairs must have nested” on the Tacoma golf links at the turn of the century”. Is this to be our standard of thorough scientific numbers, a casual golf comment in 1900 and a “report” from somebody in 1850? Does this kind of analysis qualify as solid scientific data and are we to accept this kind of subjective comment as valid science? Folk lore is given as much weight in this study as fact and I find that disturbing. I am most concerned about the report’s casual presumptions the gopher is in low numbers
because at best the scientists were guessing, using estimates, and never mentioned what numbers of gophers might live on private land.

Has any research effort investigated other causes for the demise of the threatened species such as disease, volcanic disturbance, climate change, or other natural cause besides all the raptors, dogs and cats that eat them? How can it be demonstrated that habitat reduction is actually affecting the demise of these creatures in a significant way, more so than these other variables? Has the study conclusively demonstrated the proposed land restrictions in Thurston County alone will meaningfully assist the threatened species in a way that is expected to restore their population?

Apparently the motivation for urgent public action now is an EPA threat with far worse restrictions. What specific restrictions might the EPA put on Thurston county residents which would be worse than the proposed county law changes? What other counties in America have fallen “victim” to stricter EPA rules and what were the consequences? Specifically, why do our commissioners and other county leaders suppose land restrictions will prevent a worse outcome? Do you have real data, numbers, case studies; if so please tell the public.

Who paid for the study? There is mention of only the one study on the website. Were any other studies done, by whom, and how were they paid for? What are the credentials of the scientist(s) who performed the study? What educational, professional, and expert qualifications did the scientists have?

Please disclose to the county residents why you think the study was solid, well collaborated, and of the highest level of scientific excellence. Why isn’t that information obvious on the website? How will you be able to assure the many residents who are counting on more restrictive land use laws to benefit the four species in question, that land restrictions will provide the desired benefit? Importantly, do you have alternate plans should the restrictions not work – fail to improve the numbers of the endangered species? Will the land owner rights be returned?

And one question about the “native” aspect of the mazama pocket gopher. The report mentions that native Indians destroyed natural areas by burning them to create prairie conditions theoretically necessary for the gopher. How can it be determined the gopher is an actual native species since apparently they could not have invaded this area without the intervention of man?

Concerning the lark, the summery mentions that “the streaked horned lark (Eremophila alpestris strigata) is arguably the most distinct subspecies of horned lark. Its historic breeding range included prairies and open grassland habitats in southwestern British Columbia, western Washington, and western Oregon.” This information does not convince me that Thurston county residences alone should be unfairly burdened with the larks survival. Unless every neighboring county, state and country takes ownership in the responsibility for the lark, no reasonable amount of sacrifice on the residents of Thurston County could possibly help it out. Please explain why Thurston County residents should alone shoulder this especially in light of the fact that as soon as we get some golfers idea’s of a desirable population of larks, they could just fly off and tee us all off.
The bigger picture

Beyond environmental concerns it is not clear if any other criteria were seriously considered for changing the county laws. Did any other factors go into the proposed law changes? Have economic consequences to land owners been studied, evaluated and explained to the public? (I didn’t see any mention of it on the county website only tons of new fees imposed on “non-conforming” residents. This sounds like a handy way for the county to make money.) What components of the proposed law are made for returning rights back to the people once the threatened animal populations have returned to the healthy level determined by the golfer in 1900? Bald eagles, once on the endangered list, now frequent not only my back yard, but downtown Olympia, all along I-5 to downtown Seattle. It turned out they were nowhere near as fragile as the scientists initially insisted they were. From the summery report the gophers have already “evolved” and adapted to the forested lands burned off by Native Americans, so it seems reasonable they could adapt again.

Share the load

Why is the county using the negative wording “non compliant” for every existing structure that might not meet the proposed severe new restrictions? It almost sounds like you want to bully people for abiding by former county laws then charge them with punishing new fees. Why not use a positive classification such as “previous standards compliant”? For previous standard compliant structures, why not make the “reasonable use exception” free of charge for such cases— after all they were constructed legally, these structures were not “exceptions” to the then current laws. Property owners will lose significant options to build and use their land as they are allowed to today. Additionally these new restrictions will impose expensive fees and many more public hearings for a large number of people who just need to do routine/necessary maintenance on their property. Have you estimated how many residents will need a hearing just to repair damage from a harsh winter because under the new law their homes or utilities now stand inside a restricted zone? Does Thurston County have enough hearing judges to attend to each and every repair/remodel job requested in a reasonable timeframe?

It is unfair to impose new fees only on those that happened to be unfortunate enough to become “non compliant” under the proposed law. Explain why the burden of environmental costs should not be fairly and equally shared by all Thurston county residents.

I’d appreciate county officials informing residents via their property tax bill when new fees are being considered.

Soil consideration

It appears from the information I could find, pay dirt has been found in Thurston County for the gopher. Besides declaring the gopher in Thurston County a super special “sub species” (please explain clearly how that got determined. I’m hoping it wasn’t a comment overheard while golfing), somebody arbitrarily invented a new soil here and named it. I’m guessing a new name for dirt helps justify habitat
for gophers, somehow. The public has a right to know: 1) who came up with this new dirty name, and why, 2) who paid for the study, and why, 3) what was the level of scientific expertise for the soil study, and 4) was there peer agreement for the specialized soil classification? Explain why the public should not think the soil name was just made up.

*It’s about time*

The study suggests we are to believe a certain period of time in history should set the standard for wildlife population goals, and clearly that was before the “destructive” Euro-Americans showed up. (Curiously, Native Americans are given a very positive light for slash burning, which the study suggests created a happy habitat for these species. Polluting the environment with smoke apparently was good for the gopher.) Why would we not look at reintroducing the bear, wolf, etc. back into Thurston County also? Perhaps there is a sub species of Thurston county bears in need of protection (and there were bears here 100 years ago). If we only choose some animals it seems like we’re making very selective and convenient management choices catering to overzealous environmentalists, over-reaching regulatory bureaucrats and overly greedy county officials.

*Natural selection, as Stinson decides, not nature*

The other major presumption in this report is for some unstated reason the succession of natural forests is not right; apparently natural succession of the forest is bad because these species can’t survive in the forests. So the opinion is forests are “bad” even though forest succession is a natural part of nature.

I hope these questions and concerns are not new for you; I hope you readily know all the answers, exhausted all other lesser extreme options and can in good conscience explain why the proposed laws are the best and only option for Thurston County. I am embarrassed county officials would seriously consider one report full of legend, guesses, incomplete data, and ridiculous assumptions as the factual basis for severe land restrictions. This is a travesty you should not be proud of.

Thank you,

Susan Ensign
Dear Mr. Deffobis,

Thanks for the hard work on the updated CAO, and the balance you are striking between immediate and longer term ecological and social needs. Your work is excellent, and I fully support the direction the county is going. In particular, we need:

- Need wide buffers, especially for the marine shorelines. Science tells us that the buffers should be up to 1000 feet wide.
- Clearing and Grading should be prohibited in all riparian habitat buffers and conditionally allowed in management zones.
- Shoreline armoring language should promote soft over hard armoring.
- More use of enforcement, education, incentives (through expansion of the open space tax benefit program) should be included.
- The wetlands buffers are good and in accordance with Department of Ecology recommendations.

Thank you.

Emily Lardner
2722 Country Club Rd NW
Olympia, WA 98502
Dear Mr. Deffobis,

Thanks for improvements to draft Critical Areas Ordinance. I support the following recommendations:
- Wide buffers (1000 feet), especially for the marine shorelines.
- Clearing and Grading should be prohibited in all riparian habitat buffers and conditionally allowed in management zones.
- Shoreline armoring language should promote soft over hard armoring.
- More use of enforcement, education, incentives (through expansion of the open space tax benefit program) should be included.
- The wetlands buffers are good and in accordance with Department of Ecology recommendations.

Thank you.

Maria Ruth
2520 Wedgewood Ct. Se
Olympia, WA 98501
Sent from my iPhone

Begin forwarded message:

From: "tcboce" <tcboce@co.thurston.wa.us>
Date: June 24, 2012 8:16:38 AM PDT
To: "Robin Courts" <Courtsr@co.thurston.wa.us>, "Donald Krupp" <Kruppd@co.thurston.wa.us>, "Vickie Larkin" <LarkinV@co.thurston.wa.us>, "Becca Pilcher" <pilcher@co.thurston.wa.us>, "Sandra, ThurstonCo. Commissioner Romero" <RomeroS@co.thurston.wa.us>, "Karen Valenzuela, Thurston Co. Commissioner" <ValenzK@co.thurston.wa.us>, "Danielle Westbrook" <Westbda@co.thurston.wa.us>, "Cathy Wolfe, Thurston Co. Commissioner" <Wolfec@co.thurston.wa.us>
Subject: Fwd: critical areas ordinance

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06/24/2012 08:16 AM >>>

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***************

Subject: critical areas ordinance

Sender Name: Linda Murphy and Dave Cheal

Sender Email:

Sent: 6/24/2012 8:16:22 AM
Sender Message: We were unable to attend the hearing but want to record our support for the critical areas ordinance. We believe an ordinance that provides strong protections for environmentally sensitive areas is a moral and legal imperative. We appreciate your commitment to preserving the quality of life we enjoy and that of future generations.

<Mime.822>
Sent from my iPhone

Begin forwarded message:

From: "tcboce" <tcboce@co.thurston.wa.us>
Date: June 23, 2012 5:00:37 PM PDT
To: "Robin Courts" <Courtstr@co.thurston.wa.us>, "Donald Krupp" <Kruppd@co.thurston.wa.us>, "Vickie Larkin" <Larkin@co.thurston.wa.us>, "Becca Pilcher" <pilcher@co.thurston.wa.us>, "Sandra, ThurstonCo. Commissioner Romero" <RomeroS@co.thurston.wa.us>, "Karen Valenzuela, Thurston Co. Commissioner" <ValenzK@co.thurston.wa.us>, "Danielle Westbrook" <Westbda@co.thurston.wa.us>, "Cathy Wolfe, Thurston Co. Commissioner" <WolfeC@co.thurston.wa.us>
Subject: Fwd: Today's hearing

"""" <webserver@co.thurston.wa.us> 06/23/2012
05:00 PM >>>

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* * * * * * * * * * * * * * * * * * *

Subject: Today's hearing

Sender Name: Burt Guttman

Sender Email: guttmannb@evergreen.edu

Sent: 6/23/2012 5:00:25 PM
Sender Message: The Hon. Sandra Romero The Hon. Karen Valenzuela The Hon. Kathy Wolfe Dear Commissioners . . . Dear friends, Well, this morning certainly didn’t go as I had expected or intended! I came to the meeting with the expectation of giving you my unqualified support, as a lonely (or even lone) voice among the angry voices of a lot of ultraconservatives. I arrived around 8:40 and joined a line of people who had obviously come to protest, surrounded by huge protesting banners and S.T.O.P. signs, and I was handed a sheaf of protesting literature. And I had to surrender my precious Swiss army knife to enter the building. I was number 25 in line to speak, and I sat there fixing my notes.
for my little speech, listening to the other speakers. And little by little something began to trouble me. Of course, there were the usual protests that I expected—the Libertarian and Tea-Party-type protests about property rights, about our rights being stolen from us, about how all government does is steal our liberty and let’s kill all government. But I began to hear quite simple, deeply moving stories that began to whisper in my ear—in my conscience—“Something is wrong!” So when my turn came to speak, you saw that I was still in the midst of formulating my thoughts and quite uncertain about what I wanted to say. I did say the essential message: There was a time when we did all kinds of terrible things to the earth because we didn’t have a scientific understanding of what we were doing, and there were relatively few of us anyway; but now we do have that scientific understanding, and there are a lot more of us, so everyone’s actions have to be regulated on the basis of that science. And since the science keeps advancing, the regulations have to be updated now and then. So, on the whole and in general, I support your updating of the regulations. But I tried to make two other points: first, that the scientific attitude is to look at a situation objectively and see what is really there, what is really going on; second, that science is a fundamentally humanistic activity. Now, with regard to the first point: I heard people telling you stories about their land, stories suggesting that something is badly wrong with how the regulations are being applied to them. I think I heard people saying that they had valuable timber land, perhaps formerly worth millions of dollars, but that the land had now been declared a wetland and was now worth nothing. I think I heard people saying that their business was ruled to be within buffer boundaries of a wetland so that they were unable to make changes—which they deemed reasonable—that would allow them to stay in business. I heard stories suggesting that what ought to be a fundamentally humanistic operation was somehow antihumanistic. I do not know, of course, just what might be wrong, but what I heard suggested a hypothesis: that the actions of County staff in dealing with particular cases may be at fault. Don’t ask me just what the fault(s) might be; perhaps someone is misinterpreting some regulations; perhaps someone is not using common sense; perhaps someone is simply not using that objective, scientific attitude in looking at a particular situation and seeing what is really there . . . and what must really, truly be done to protect the land and the local ecology. I’ve driven by all the S.T.O.P. signs around the County, and I’ve seen the quiet anger. The anger I saw this morning was not quiet, and I was glad we all had to surrender our Swiss army knives or worse to get into the building and that there were several Sherriff’s deputies standing by. Something is going on that is more widespread and deeper than mere Tea-Party anger. People are being hurt, seriously. Yes, we must protect our ecology, our water, and so on, and yes, we are moving into a new kind of world that will sometimes be very hard on ordinary people and that they will not understand. But we cannot kick people and say, “Take it!” For one thing, we ourselves are not that kind of people. We are humans with genuine feelings for other humans. (Did any of you happen to read my Wednesday editorial in The Olympian about the true importance of education?) Furthermore, an oppressed people will not stay oppressed forever. At the very least, they will rise up and throw you out of office and replace you with right-wing radicals, and that will be very bad for everyone. I want the three of you to stay in office and continue to do very good work for Thurston County. I will suggest, quietly, that we (and don’t ask me just who I include in that “we”) need more of a cooperative relationship with County landowners to replace the antagonism that obviously exists now. Some of the people speaking this morning clearly see themselves as stewards of their land, as lovers of their land, and I’m sure this attitude is widespread and genuine. Then why not take advantage of that love for the land? Why not replace regulation from outside with education, with creating understanding of the local ecology and the needs of water, wildlife, and so on, with the development of stewardship relationships. If we are just smart enough, and, yes, scientific enough, and, yes, humanistic enough, we should be able to develop ways for
everyone here to live together in reasonable harmony, with one another and with the land. This has obviously shaken me up a bit. I may have more to tell you later. Cheers and best, Burt Burt Guttman The Evergreen State College Olympia, WA 98505 guttmnb@evergreen.edu Home: 7334 Holmes Island Road S. E., Olympia, 98503

<Mime.822>
To whom it may concern,

I am opposed to the critical area ordinance currently being proposed. I own 40 acres of land located at 9021 and 9023 Rainier Rd SE. Yesterday was my first attendance to a public meeting concerning the ordinance, and I was shocked by the various presentation made by all. During my time there (prior to the first break), there was only one supporter for the CAO, and she was a Senior Official with LOTT, and obviously had her own agenda. Even the head of the Biology Dept at Evergreen said that you need to go back to the drawing boards. Obviously those of us affected by thee ordinance do not want to see it passed. We have enough problems with the existing CAO, and most certainly don't need more rules and regulations imposed upon us.

One point reoccurring throughout the presentations which I strongly second: If the people of Thurston County choose to elect officials that pass legislation which devalues privately owned property in anyway (including diminishing previously held rights to develop, or utilize for personal or commercial means that were present when said property was acquired), then the people of Thurston County, and elected officials should incorporate into said legislation appropriate compensation for the lost value at current market rates. This should include a Citizen panel representative of the district to which the property belongs should be appointed through some impartial means to arbitrate any disputes over compensation.

Very simply put: "If you want to take away my property rights, then compensate me for it"! Unless I'm mistaken, this is a basic premise of our Constitution.

Regards,

R. Kirkman
9023 Rainier Rd SE
Olympia, WA
Dear County Commissioners,

I attended Saturday’s hearings and bore witness to the nasty way that you all were treated. To listen to the STOP folks talk, you would assume that you, the county commissioners were responsible for everything that might be going wrong in our county-- from unemployment rates, to hang-nails and on, the Critical Area Ordinance is responsible and the three of you are to blame.

I heard one woman say, "You are taking away our American Way of Life here in Thurston County." In one way, she is right-- for all too long the American way of life has been to take the earth for granted and exploit our resources to the brink of devastating consequence. Bravo to you for standing up against such rapacious behavior!

I see the CAO as a step in the right direction of change.

We can no longer afford to take our water for granted. We can not build on flood plains and wetlands and then wonder why people's whole existence is destroyed in fell swoop during the next disaster that comes our way.

It only takes a glance southward to California to see the damage done by poor management of land use. Perhaps we don't have to look as far away as California to question poor land management. I think back to the floods in Centralia and wonder, what might have been different for them? Was anyone looking at the land use in their county? I don't know the answer to that, but I think that the three of you as our commissioners are very courageous to put forward pieces of legislation that safe guard our aquifers, our geologically hazardous regions and all the rest.

I urge you to continue your brave work on the CAO. I did not testify on Saturday. For one thing, I couldn't stay for the entirety of the hearing. For another thing, to be honest, I was intimidated.

I am not an easy person to intimidate. I speak publicly for a living. I have no problems making my voice heard on issues that matter to me, most of the time. However, one has to wonder if I felt reticent to speak up, given my background,
what about others? I imagine that I am not alone in my reticence. I did not want to have a number held up rating my performance as a speaker. Talk about making democracy a mockery.

Of course this observation about the circus that hearing was has nothing to do with your leadership as County Commissioners.

I urge to hold fast to what you know is right. I believe in a sustainable model for our County. Thank you for your willingness to be good leaders in very anxious times indeed.

Regards,

George
The Rev. George Anne Boyle Vicar
St Benedict Episcopal Church Lacey WA
"The Hands of Christ in the Heart of Lacey"
Visit us on the web at: www.stbenedictslacey.org
"I believe in Christianity as I believe that the sun has risen; not only because I see it, but because by it I see everything else."
C.S. Lewis

***************

This message is intended for the sole use of the individual and entity to which it is addressed and may contain information that is privileged, confidential and exempt from disclosure under applicable law. If you are not the intended addressee, nor authorized to receive for the intended addressee, you are hereby notified that you may not use, copy, disclose or distribute to anyone the message or any information contained in the message. If you have received this message in error, please immediately advise the sender by reply email and delete the message. Thank you very much.

***************
Dear Mr. Deffobis,

This is in follow-up to the letter sent Friday so you have an electronic copy. On behalf of David Batker, thank you for distributing it to the Commissioners.

Thank you also for your hard and very worthwhile work on the CAO Update.

JenHC

Jennifer Harrison-Cox | Managing Director
Earth Economics
107 N. Tacoma Avenue
Tacoma, WA 98403
T 253-539-4801 | M 425-766-0345 | F 253-539-5054
<http://www.eartheconomics.org/> www.eartheconomics.org
June 22, 2012

Thurston County Board of Commissioners
Thurston County Planning Department
c/o Andrew Deffobis, Associate Planner
Thurston County
2000 Lakeridge Drive SW
Olympia, WA 98502

REGARDING: Economic benefits supporting the adoption of the 2012 Draft Critical Areas Ordinance

Dear Mr. Deffobis and Thurston County Commissioners:

Thank you for the opportunity to comment on the proposed Critical Areas Ordinance.

Earth Economics is an independent, non-partisan non-profit dedicated to researching and applying the economic solutions of tomorrow, today. We have recently completed preliminary economic analysis of Thurston County’s green infrastructure, including wetlands, riparian areas, shorelines, forests and agricultural lands and are pleased to offer comments on the economic benefits of these areas to the citizens of Thurston County and Washington State.

**Earth Economics strongly supports the proposed updates to the CAO based on economic arguments.** In this letter we take the opportunity to highlight economic benefits provided by Thurston County’s critical areas and the ecosystem services a healthy environment can provide the County’s citizens.

**Background:**

Natural systems provide foundational economic goods and services including oxygen, water, land, food, recreation, beauty, raw materials, minerals, and energy. All man-made things (built capital) are made of natural capital, including cars, buildings and food. An economy also requires climate stability, storm and flood protection, waste assimilation and other services that nature provides at very low cost or free.

Thurston County’s economy is comprised of a combination of natural, built, human, social and financial capital and is the outcome of previous centuries of investment. Our investments in the economy today will determine its physical appearance tomorrow, and wise investments are crucial to ensuring our well-being and economic freedom into the future. In the 21st Century, with growing scarcity of healthy functioning natural systems, our economy faces new challenges. Wise
investments require inclusion of natural systems in planning and economic decisions to meet the needs of a growing population and ensure a high quality of life for Thurston County residents.

**The Economic Value of Thurston County’s Natural Systems:**

Earth Economics has recently begun an economic study of Thurston County’s green infrastructure. This study examines the value of the county’s healthy ecosystems, such as forests, rivers, wetlands, grasslands, shorelines and agricultural lands, all provide economically valuable goods and services. These quantifiable benefits include fish, timber, drinking water and agricultural products, while services include flood protection, drinking-water filtration, local weather and climate stability, tourism and recreation.

The different ecosystem services present in Thurston County that reduce the frequency and severity of floods, supply water, buffer climate instability, support fisheries and food provision, maintain critical habitat, enhance recreation and provide waste treatment, among other benefits. **Preliminary calculations indicate that Thurston County’s ecosystems provide up to $6 billion in economic benefits to the local and regional economy every year.**

This value represents an appraisal of the County’s natural capital, similar to a house or business appraisal. This appraisal replaces the former estimate of zero that has been the default value of ecosystems.

Ecosystem services may also be treated like economic assets, as they provide a stream of benefits over time, similar to bridges, roads or other built infrastructure. Valued as such, a discount rate may be applied to these services, allowing for calculation of the present value (or asset value) of these systems. If treated like an asset with a lifespan of 50 years, the asset value of Thurston County is up to $131 billion at a 4% discount rate. **Using a 0% discount rate, which recognizes the renewable nature of natural capital and that people 50 years from now will enjoy the same level of benefits, Thurston County has an asset value of up to $305 billion.**

Time has consistently shown that investments in natural capital appreciate over time. Healthy natural systems require little maintenance to produce significant economic benefits. These benefits, if lost, must be replaced by built systems such as water filtration plants, levees and dams and water chilling plants at significant on-going cost to taxpayers. When we lose critical ecosystem services that nature provides seemingly for free, new tax districts are created to fund the infrastructure required to replace the systems or the restoration required to restore function. We have seen this across the state with our flood districts, shell fish districts and others. **Preserving and enhancing green infrastructure is always more cost effective then replacing or restoring lost critical ecosystem services.**

Earth Economics will be releasing a paper with detailed analysis, figures, valuation methodologies and applications of these economic concepts later this year.
Specific Comments to the CAO Draft

Subdivision in Critical Areas:

- New design and green building techniques should be employed to avoid mitigation. In a recent Earth Economics report: The Economics of Change, an in depth analysis describing the investment shift toward a restorative built environment stresses the relation between built capital and natural capital. For human health windows have reduced Sick Building Syndrome by 20%. Natural ventilation also reduces this syndrome and doctor visits by 15% each. The benefits of building green can be seen in productivity, employee comfort satisfaction and overall well-being.  

Fish and Wildlife Habitat Conservation Areas

- *Section 24.25.140 -* Riparian zones are essential to regulate water temperature and flow for plant and animal species. Along with forest cover and wetlands these ecosystems all contribute to modulating the flow of water from upper portions of watersheds to streams and rivers. In our 2010 Puget Sound study ecosystem services in riparian buffers of Puget Sound were found to contribute up to $2 billion dollars annually to the local, regional and national economy. Some of the ecosystem services present in these zones are: gas and climate regulation, water regulation, provide aesthetic beauty and recreational areas, supply water, regulate disturbance and create habitat and nursery areas for local fauna.

- The CAO presents an agreeable wetland buffer that is in accordance with that suggested by Department of Ecology. Wetlands in the Puget Sound are one of the most productive land cover types, in terms of ecosystem services. Puget Sound’s wetlands contribute up to $15 billion dollars annually providing services such as: nutrient cycling, gas, climate and water regulation, and water supply, among others.

- *Section 24.25.300-* Shoreline and Slope Stabilization as suggested should follow more clearly the mitigation efforts. Shoreline is an important land cover in Washington State. Not only does the shoreline create essential habitat areas for marine life but provides coastal areas with significant disturbance regulation services, which contribute up to $4 billion a year.

Agriculture Critical Area Ordinance:

- In Chapter 17, the CAO, mentions best management practices (BMP) this definition focuses on regulation of pollution, what should specifically be pesticides. A study in Ontario Canada, also acknowledges the benefits of valuing natural processes on agro-environmental farms. Through various plans and programs agro-environmental farms are targeting to decrease emissions,

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1 Twill, J. Batker, D. Cowan, S. Wright Chappell, T. 2011. The Economics of Change: Catalyzing the Investment Shift Toward a Restorative Built Environment. Earth Economics, Tacoma WA.
3 Ibid
4 Ibid
enhance farming practices and augment environmental outputs. These programs engage with local landowners, industries, research institutes and other NGO’s. Ecologically sound practices may lead to tax reductions and internal expense savings. The shift from common practices to ecologically sound alternatives has environmental and economic benefits.\(^5\) **Agricultural lands account for many ecosystem services and this land cover contributes annually up to $3 million to the Puget Sound area.**\(^6\)**

**In Conclusion**

Ecosystems in Thurston County in many ways determine the county’s economic health and the quality of life for all its citizens. Healthy watersheds enable cities, communities, households and their residents to thrive. However, society has underinvested in maintaining their ecosystems. When free flood protection provided by natural systems is lost, the flood protection service must be replicated with levees, and flooded houses fixed. When salmon, drinking water, storm water conveyance, local climate regulation and other benefits disappear, the economy suffers from both the direct damage and the expensive tax districts and construction costs that are needed to replace natural capital.

We offer these comments to be part of the public record and encourage adding additional language to the CAO Draft to explain and support the CAO as an economically prudent policy of Thurston County.

Sincerely,

David Batker
Executive Director, Earth Economics
Andrew Deffobis - CAO Hearing

From: <dfisher108@comcast.net>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
Date: 06/24/2012 6:20 PM
Subject: CAO Hearing
CC: Roger Bogden <rbogden@comcast.net>, Teri Fisher <tfisher775@aol.com>

06/24/2012

Andrew Deffobis
Associate Planner
Thurston County Resource Stewardship

Dear Sir,

I did attend the recent hearing regarding the update of Thurston Co. CAO. I did not speak but I do want to let you know my feelings pertaining to this issue. I until very recently would have supported you 100%, however after some recent and ongoing experience with your agency I would simply say "No Change, Enforce What You Already Have In Place". It appears that you do not follow guidelines you have established and you even ignore the state guidelines. I am referring to the SEPA process that was waived and in the case of an adjacent landowner your agency chose to waive all setbacks and allow him to utilize an existing access road directly through and crossing an existing wetland with absolutely NO Stipulations or Conditions. This road was used previously only during the dry season and during dry years due to flooding. The water levels are directly proportional to the amount of rainfall and runoff received during the wet seasons and controlled by decades old beaver dams. These beaver dams were in existence prior to our purchase of this property in the early 1970's. Your agency has now put us in the untenable position of defending this wetland because of threatened litigation by the resident at 4815 Pleasant Glade Rd. NE due to water backing up onto his property and over this previously seasonal access road. He is demanding we lower and maintain an elevation that is roughly 2.5 feet lower than it currently is. This would actually dry up and destroy up to and maybe over ½ of this approximately 12 acre wetland. This is not only affecting our way of life and peace of mind but financially as well due to the impending legal threats. This is all due to your agency not doing its homework and failing to follow simple guidelines, obviously with little or no regard for the consequences of your decisions.

I may be contacted by phone at (360)870-3901 or email at dfisher108@comcast.net

Sincerely,

Don Fisher
4841 Pleasant Glade Rd NE
Olympia, WA 98516
To whom it may concern: I would like to voice my concern on the proposed Critical Area Ordinance. I am one of the many who attended the hearing on the proposed Critical Area Ordinance on Saturday, June 23rd. My family is very much like so many I heard yesterday being affected. Our family has had the property from our great grandparents on Rich Road. Through the years this property has provided alfalfa hay, corn, vegetables, and livestock to feed our families and provide financial means as well. Our grandparents and parents have taught us the rural way of life—agriculture. Listening to how this new ordinance will affect my family as well as other families throughout Thurston County, it is very hard to hear that the agriculture life will die in Thurston County. The people in the city will no longer learn about animals, how to feed them, how vegetables are grown, 4-H clubs will disband, unemployment will continue to go up, people will not be able to sell their homes and property in Thurston County, etc. One thing I continue to hear politicians say to the American people how they want the American people to take care of ourselves financially and not depend on the government to take care of us. There will be more people in food and unemployment lines because small businesses (farms and other small businesses) have closed.

Farmers and the rural people in many counties in Washington have grown food for so many and have donated to many who can't afford food. I ask that you really think about how this ordinance is going to affect so many in this county financially and the next generation. We will not be able to teach the next generation about the rural way of life our grandparents taught us—farms—agriculture. Thank you.

Susan Elwanger
Sent from my iPhone

Begin forwarded message:

From: "tcboce" <tcboce@co.thurston.wa.us>
Date: June 25, 2012 12:39:07 AM PDT
To: "Robin Courts" <Courtstr@co.thurston.wa.us>, "Donald Krupp" <Kruppd@co.thurston.wa.us>, "Vickie Larkin" <Larkinv@co.thurston.wa.us>, "Becca Pilcher" <pilcher@co.thurston.wa.us>, "Sandra, ThurstonCo. Commissioner Romero" <RomeroS@co.thurston.wa.us>, "Karen Valenzuela, Thurston Co. Commissioner" <ValenzK@co.thurston.wa.us>, "Danielle Westbrook" <Westbda@co.thurston.wa.us>, "Cathy Wolfe, Thurston Co. Commissioner" <WolfeC@co.thurston.wa.us>
Subject: Fwd: Critical Areas Ordinance

"""" <webserver@co.thurston.wa.us> 06/25/2012 12:38 AM >>>

********** ***********
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********** ***********

Subject: Critical Areas Ordinance

Sender Name: Robert Whitlock

Sender Email: robertfwwhitlock@gmail.com

Sent: 6/25/2012 12:38:52 AM
Sender Message: Dear Commissioners, I heard of the tensions at the CAO public hearing. I am sorry that I missed being there to support strengthening protections for wetlands. I strongly support strengthened environmental protections. Thank you for your efforts on behalf of a healthy environment. Sincerely, Robert Whitlock

<Mime.822>
Hey Andy --

Here come the comments :) Received quite a few I will be forwarding.

Thanks.
Robin

>>>  
From: <webserver@co.thurston.wa.us>  
To: <tcbocc@co.thurston.wa.us>  
Date: 6/22/2012 3:24 PM  
Subject: CAO  

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Subject: CAO

Sender Name: Darrell Hoppe

Sender Email: sierra.hiker@gmx.com

Sent: 6/22/2012 3:24:35 PM  
Sender Message: Keep up the good work. I support the CAO revisions. Hope to be there Saturday. Darrell
Andrew Deffobis - Fwd: critical areas ordinance

From: Robin Courts
To: Deffobis, Andrew
Date: 06/25/2012 8:01 AM
Subject: Fwd: critical areas ordinance

>>> From: <webserver@co.thurston.wa.us>
To: <tcbocc@co.thurston.wa.us>
Date: 6/22/2012 5:41 PM
Subject: critical areas ordinance

***************
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***************

Subject: critical areas ordinance

Sender Name: Steve Lundin

Sender Email:

Sent: 6/22/2012 5:41:07 PM
Sender Message: I am in total support of the proposed critical areas ordinance. Please enact it without amendments weakening the ordinance.
From: <webserver@co.thurston.wa.us>
To: <tcbocc@co.thurston.wa.us>
Date: 6/22/2012 7:43 PM
Subject: Adoption of the Proposed Critical Area Ordinance

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Subject: Adoption of the Proposed Critical Area Ordinance

Sender Name: Patrick Sampson Babineau

Sender Email: patsambab@comcast.net

Sent: 6/22/2012 7:43:09 PM
Sender Message: Dear Thurston County Board of Commissioners: I am writing to ask that you as the Board of County Commissioners adopt the proposed Critical Area Ordinance (CAO), which is long overdue. The Growth Management Act requires counties to update their CAO every seven years, yet Thurston County has not really updated its CAO in any comprehensive way for almost 18 years. It is long overdue that the county put into place provisions which can protect the county’s natural resources for those who are residents now and for those future generations of people that will call Thurston County their home. My understanding is that the CAO update changes are based on the best available science we have available to us now. My hope is that the CAO be adopted and implemented in a way that serves the best interests of the residents of the county.
Sincerely, Patrick Babineau Resident of Thurston County 3043 Wilderness Dr., SE Olympia, WA 98501 Cc: Scott Clark, Planning Director
Andrew Deffobis - Fwd: Critical Areas Ordinance

From: Robin Courts
To: Deffobis, Andrew
Date: 06/25/2012 8:02 AM
Subject: Fwd: Critical Areas Ordinance

>>>>
From: <webserver@co.thurston.wa.us>
To: <tcbocc@co.thurston.wa.us>
Date: 6/23/2012 8:14 AM
Subject: Critical Areas Ordinance

***************
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***************

Subject: Critical Areas Ordinance

Sender Name: Allen Zimmerman

Sender Email:

Sender Message: It is critically important to support the findings and work of the planning commission and the commissioners in their pursuit of compliance with the Growth Management Act and the long term interests of the citizens of Thurston County. Too much big money is being spent by the Farm Bureau and the builders Association to undercut and weaken the protections we all need to keep some semblence of the natural conditions necessary for the environment we need to survive. I shudder to think what the county would look like if left to the devices of individual and corporate short term monetary pursuits with no obligation to the good of the whole. It would be akin to New York Traffic without stop lights.
From: Robin Courts
To: Deffobis, Andrew
Date: 06/25/2012 12:11 PM
Subject: CAO Comment
Attachments: 1424_001.pdf

Hey Andy -

Would you please add this to the CAO file of public comments? Thanks.
Robin

>>>}

From: "Thurston County BoCC" <ScanOPBD@co.thurston.wa.us>
To:"Robin" <Courtsr@co.thurston.wa.us>
Date: 6/25/2012 12:06 PM
Subject: Scanned document from C5185i
Thurston Co. Comm.
Thurston Co. Courthouse
Bldg One Rm 269
2000 Lakeridge Dr SW
Olympia, Wa 98502

June 20, 2012

3445 14th Ave NW
Olympia, Wa 98502

Dear Commissioners,

This is America, known as a free people who live on and benefit from their land whether it is a city lot with a house and garage or a 250 acre farm !! We love that land whether we dig our fingers in it or just stand on it. It is our RIGHT to have this land we have earned through the sweat of our brow or the sweat of our fathers brow !! It is ours !!

There have been times when shots were fired in protecting our land. This has been frequently shown to have been justified. Hopefully, we can now find other means.

We know that right of protecting our land may stop at our property border and we must consider what we do if it conflicts with our neighbors rights, for he also has to be considered in what we do. However, that same neighbor has no right to complain if a smell coming from our property was plainly there when the neighbor moved in. That smell was a part of the property he purchased.

If we raise as much as 6 chickens (without roosters) why should the neighbor complain? How close are they to the property line? This may be a city problem, not a county one. This may be a question decided between neighbors not the county commissioners. Horses on one acre? Not good for the horses ! Can we raise a garden? Why not? Can we sell what we raise/ Why not? Would a small products stand on a county road affect traffic ? The sheriff takes care of it not the county commissioners.

What we are talking about is a freedom all Americans have had for centuries !! If that freedom is lost, well then, perhaps so is America lost !!

Very truly yours

Howard Bullpitt

cc Farm Bureau
From: Cathy Wolfe, Thurston Co. Commissioner
To: Deffobis, Andrew
Date: 06/25/2012 3:35 PM
Subject: Citizen Comment for the Record: Fwd: Critical area Ord

vickie

>>> From: <webserver@co.thurston.wa.us>
   To: <wolfe@co.thurston.wa.us>
   Date: 06/25/2012 6:58 AM
   Subject: Critical area Ord

   ** ******************************************
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   ******************************************

   Subject: Critical area Ord

   Sender Name: Jon Pettit

   Sender Email:

   Sent: 6/25/2012 6:58:47 AM
   Sender Message: Commissioners, You are aware of who I am and that do not support certain actions that the board has taken. That being said, I do not want you subject to unpopular public opinion for something you probably did not directly create, the revised Critical Area Ord. You are the figureheads above the employees of sub-departments. As I mentioned in my testimony Saturday, I feel sorry for you, as I believe you are receiving the blame for the rouge Planning Department. Much like another issue you addressed earlier this year, the Shooting Ord. you can certainly present a lack of supporting evidence, for a need to change from the current CAO. You did your job as to ordering a review to update the current CAO. The question is; have you found any actual "events" that the current CAO when followed, failed to protect the environment? If the answer is an overall NO, then setting the issue to conclusion of "No Change" will serve the public well and put to rest on this issue. The people do not like change from the status quo. You need to have a very good reason, that you can convince the people thereof, as to why they need to accept your leadership decisions. If you can't present a good enough reason, they will find new leaders to keep them in their comfort zone. Hope you make the right decision. Jon S. Pettit
From: "Vadas, Robert (DFW)" <Robert.Vadas@dfw.wa.gov>
To: "D.J.Nick@comcast.net" <D.J.Nick@comcast.net>, Andrew Deffobis <deffoba@
Date: 06/25/2012 4:34 PM
Subject: FW: Knotweed Research Paper
Attachments: Knotweed mechanisms_JEC_online early.pdf

FYI re: county CAO?

From: Jill Silver [mailto:jsilver@10000yearsinstitute.org]
Sent: Friday, June 22, 2012 7:22 PM
To: 'Deborah Rudnick'; Deborah McConnell; 'Luke Cherney'; 'Alison Osullivan'; Vadas, Robert (DFW);
eiliott@greenbeltconsulting.com; 'Eve Dixon'; 'Michael Pollock'; 'Hans Daubenberger'; 'Hilton Turnbull';
'Frank Staller'; 'Kevin Aitkin'; Pleus, Allen E (DFW)
Subject: FW: Knotweed Research Paper

Very helpful.

Please share...

Jill

Jill Silver
10,000 Years Institute
892 53rd Street
Port Townsend, WA 98368
360.385.0715 office
360.301.4306 cell
jsilver@10000yearsinstitute.org<mailto:jsilver@10000yearsinstitute.org>
www.10000yearsinstitute.org<http://www.10000yearsinstitute.org>

From: Lauren S. Urgenson [mailto:lsu@uw.edu]
Sent: Friday, June 15, 2012 2:33 PM
To: frank.geyer@quileutenation.org<mailto:frank.geyer@quileutenation.org>; Lucero, Frances; Lucero, Cathy; Alaine Sommargren; Deborah Oaks; sowerp@gmail.com<mailto:sowerp@gmail.com>; Jill Silver; joshua.chenoweth@nps.gov<mailto:joshua.chenoweth@nps.gov>; twmiller@wsu.edu<mailto:twmiller@wsu.edu>; Lizbeth Seebacher; rbrown@ewu.edu<mailto:rbrown@ewu.edu>; Sonny.Gohrmann@snoco.org<mailto:Sonny.Gohrmann@snoco.org>; LBaldwin@co.whatcom.wa.us<mailto:LBaldwin@co.whatcom.wa.us>; sclaeson@fs.fed.us<mailto:sclaeson@fs.fed.us>; Anna heckman; Rodney Pond; SHARON L. DOTY; Kern Ewing
Subject: Knotweed Research Paper

Dear Folks,

Attached is our latest paper on the ecological consequences of knotweed invasion in PNW riparian systems. The paper is available early on-line from the Journal of Ecology web-site. Please pass along to any others who may be interested.

All my best,

Lauren

--

Lauren S. Urgenson, PhD
School of Environmental and Forest Sciences
University of Washington
Seattle, WA 98195-4115
lsu@u.washington.edu<https://ap14.alpine.washington.edu/alpine/alpine/2.0/mailto?to=lsu%40u%2Emwashington%2Eedu&pop=view/0/INBOX/58107>
Multiple competitive mechanisms underlie the effects of a strong invader on early- to late-seral tree seedlings

Lauren S. Urgeson*, Sarah H. Reichard and Charles B. Halpern

School of Environmental and Forest Sciences, Box 352100, University of Washington, Seattle, WA 98195-2100, USA

Summary

1. Certain non-native invaders reduce the species diversity and alter the structure of natural communities by displacing native species with differing life histories, successional roles or resource requirements. Few studies have tested the potential for these ‘strong invaders’ to exert multiple mechanisms of control on natives that differ in these traits.

2. We assessed the mechanisms by which bohemian knotweed (Polygonum × bohemicum) regulates seedling growth and survival among early-, mid- and late-seral tree species in a riparian forest ecosystem in western North America. We used general linear mixed models to compare seedling performance (survival, height and diameter growth, biomass allocation and ectomycorrhizal colonization of root systems) over two growing seasons in paired experimental plots from which knotweed was either removed or retained (controls). Seedling performance was assessed relative to the effects of knotweed on light and soil resources and the traits of the native species.

3. Results from paired t-tests suggest that knotweed had a significant effect on light availability (> 85% reduction), but small, mostly non-significant effects on measured soil properties. Knotweed imposed strong controls on growth and survival of all three tree species. The apparent mechanisms of interaction varied in a manner consistent with species’ ecophysiology. Reduced survival of early- and mid-seral species was correlated with light limitation beneath knotweed (≤ 7% of ambient levels); light transmittance was significantly higher (79%) above surviving seedlings. Knotweed also exerted strong controls on the late-seral species, reducing survival by 24% and height and diameter growth by 91–122% and 37–55%. These effects were not correlated with reductions in light. Instead, in the presence of knotweed, ectomycorrhizal colonization was significantly reduced (64%) and root/shoot ratio was significantly increased, suggesting a disruption of soil mutualisms.

4. Synthesis. We demonstrate that strong invaders can displace co-occurring native species through multiple mechanisms that are consistent with the functional traits of native species. To our knowledge, this is the first study to relate community-level impacts of an invader to the combined effects of resource exploitation and interference of below-ground mutualisms. Where invaders have the ability to displace early- to late-seral dominants, the consequences for community structure and ecosystem functioning can be profound.

Key-words: competition, ectomycorrhizal fungi, interference, invasion ecology, mycorrhizae, native–alien interactions, riparian forest, species’ interactions, tree seedlings

Introduction

Non-native invasive plants that develop dense monotypic stands can dramatically alter the structure and dynamics of native plant communities (Parker et al. 1999; Muck et al. 2000; Byers et al. 2002). The mechanisms by which invasive plants displace natives are often poorly understood (Levine et al. 2003). Certain ‘strong’ invaders (sensu Ortega & Pearson 2005) or ‘transformers’ (sensu Richardson et al. 2000; Pyšek et al. 2004) may reduce community diversity because they can displace native species with distinctly different life histories or resource requirements. However, little is known about the mechanisms that underlie the interactions of strong invaders (or transformers) with multiple coexisting species. The majority of studies consider interactions with individual native species or treat all native species as belonging to a common group (Parker et al. 1999; Ortega & Pearson 2005). In contrast, few, if any, studies have explicitly tested the potential for...

*Correspondence author. E-mail lsu@uw.edu

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invaders to exert different mechanisms of control on species (or groups of species) with differing functional traits (Ortega & Pearson 2005). Elucidating the diversity of processes by which invasives can displace multiple native species within a community is fundamental to predicting the broader impacts of invasions and to mitigating or managing their effects (Levine et al. 2003; MacDougall & Turkington 2005; Reinhart et al. 2006; Farrer & Goldberg 2009).

Competition or interference from invasives can take multiple forms: reductions in light or soil resources (Kourtev, Ehrenfeld & Haggblom 2002; Ehrenfeld 2003; Reinhart et al. 2006), allelopathic interference (Bais et al. 2003) and disruption of mycorrhizal associations that enhance resource uptake (Marler, Zabinski & Callaway 1999; Callaway et al. 2008). Natives with differing life histories or resource requirements may vary in their sensitivities to the changes imposed by invading species (Chapin et al. 1987; Tilman 1990; Grime 2002; Ortega & Pearson 2005). For example, early- and late-successional species have inherently different resource requirements, with early-seral species characterized as sun adapted and late-seral species as shade adapted (Bazzaz 1979; Tilman 1988). Thus, whereas competition for light may be an important mechanism of interference in early successional species, late-seral species should be more sensitive to changes in below-ground resources.

When faced with competition for resources, species may adjust allocation of biomass to resource-acquiring structures depending on the nature of resource limitation or other constraints (Bloom, Chapin & Mooney 1985; Chapin et al. 1987; Callaway, Penning & Richards 2003). Plants may allocate more biomass to roots and rhizomes when soil nutrients are limiting (Gedroc, McConnaughay & Coleman 1996; Hodge 2004) or to avoid allelochemical influences (Ridenour & Callaway 2001). Allochemical plasticity may thus contribute to differential growth and survival in the face of invasions (D’Antonio & Mahall 1991; D’Antonio et al. 1998). An understanding of the interplay between invasion-induced resource changes, native plant strategies, and competitive outcomes is essential for differentiating among the mechanisms that underlie the displacement of natives by invasives.

In this study, we investigate the potential mechanisms by which a notorious strong invader – bohemian knotweed (Polygonum × bohemicum) – regulates the growth and survival of native tree seedlings in riparian forests of the Pacific Northwest, USA. Knotweed is an herbaceous perennial that invades low-elevation river corridors and tributary channels throughout North America and Europe, where it can form tall, dense stands that are difficult to eradicate (Bailey & Wisskirchen 2006; Barney 2006; Hagen & Dunwiddie 2008; Urgenson, Reichard & Halpern 2009; Holman, Carey & Dunwiddie 2010). Considered among the world’s most invasive plants (Love, Browne & Boudjelas 2000; Bailey 2003), knotweed possesses a diversity of traits that may reduce establishment and survival of native tree species in heavily invaded sites. These include dense canopy cover (Siemens & Blossey 2007); allelopathic, antifungal, and antimicrobial chemical properties (Inoue et al. 1992; Beerling, Bailey & Conolly 1994; Konstantinidou-Doltsinis & Schmit 1998; Kumagai et al. 2005; Weston, Barney & DiTommaso 2005; Vrhotová & Šerá 2008; Murrell et al. 2011); an extensive rhizome system (Smith et al. 2007); and the ability to compete for and retain soil nutrients (Price, Gamble & Williams 2001; Urgenson, Reichard & Halpern 2009).

Knotweed exhibits wide ecological amplitude along riparian corridors in the Pacific Northwest. It commonly occurs as a先锋 on recent alluvial deposits, but also as an understory dominant in deciduous floodplain forests. In both habitats, it appears to limit recruitment of the tree species that dominate the regeneration pool (Urgenson, Reichard & Halpern 2009): early-seral, N-fixing, Alnus rubra, on primary successional surfaces; and mid- and late-seral conifers, Picea sitchensis and Tsuga heterophylla, under established forest canopies. The co-occurrence of species with contrasting life-history strategies and resource requirements (shade intolerant vs. tolerant; N-fixing vs. N-limited) (Fonda 1974; Minore 1979; Van Pelt et al. 2006) provides an ideal system for exploring the diversity of mechanisms by which a strong invader can influence the growth and survival of native species. In addition, as the primary structural elements of these forests, Alnus, Picea and Tsuga play critical functional roles in both terrestrial and adjacent aquatic habitats – regulating microclimate, stabilizing stream banks and water flow, and providing energy and nutrients to soil and aquatic food webs (Fetherston, Naiman & Bilby 1995; Naiman, Bilby & Bisson 2000). The nature of interaction with knotweed – particularly during the establishment phase – has important implications for the conservation and restoration of these riparian systems.

Planting of seedlings is a common method of reintroducing trees to riparian forest ecosystems during restoration (Sweeney, Czapka & Yerkes 2002; Pollock et al. 2005; Keeton 2007). To explore the potential mechanisms of interaction with knotweed, we transplanted seedlings of each species into replicate paired plots from which knotweed was experimentally removed or retained along a highly invaded riparian corridor on the western Olympic Peninsula (Washington). To quantify the effects of knotweed on the physical/resource environment, we measured understory light transmittance and soil physical and chemical properties. We assessed the effects of knotweed on seedling survival, diameter and height growth, biomass allocation to shoots and root systems, and ectomycorrhizal colonization of root tips after two growing seasons. We inferred the mechanisms of interaction from effects on performance and how these related to light and soil resources in the presence or absence of knotweed.

We addressed the following questions: (i) What are the effects of knotweed on light transmittance and soil physical and chemical properties? (ii) Does knotweed invasion alter native tree seedling growth, survival, biomass allocation or mycorrhizal colonization? (iii) Do tree species differ in these measures of performance in the presence of knotweed? (iv) Are patterns of performance consistent with the effects of knotweed on light and soil resources and the life histories and resource requirements of early- to late-seral tree species? We hypothesized that knotweed would differentially affect native
species in a manner consistent with species' functional traits. Specifically, we expected early-seral species to be more sensitive to changes in light associated with the presence of knotweed and late-seral species to be more sensitive to changes in below-ground resources.

**Materials and methods**

**JAPANESE KNOTWEEDS S.L.**

Japanese knotweeds s.l. are rhizomatous perennials that were introduced to Europe and North America from Southeast Asia as horticultural species in the late 19th century. They have since become persistent invaders of riparian areas, roadsides and other disturbed habitats throughout their adventive range (Beering, Bailey & Conolly 1994; Barney 2006; Bailey, Binová & Mandák 2007). The primary invasive taxa include giant knotweed (*Polygonum sacchari-ne F. Schmidt ex Maxim*), Japanese knotweed (*Polygonum cuspidatum Sieb. & Zucc.*) and their hybrid, bohemian knotweed (*P. × bohemicum J. Chřtěk & Chříčková*). The taxonomy is subject to debate, and some authors place these species in the genera *Fallopia* or *Reynoutria*. *Polygonum* is the most common usage in western North America. Morphologically, the plants in our study area resemble *P. × bohemicum*, the most abundant taxon in the Pacific Northwest (Zika & Jacobson 2003). It results exclusively from the hybridization of *P. cuspidatum* and *P. sacchari-ne* in their sympatric introduced ranges. Plants from Europe exhibit advanced generative capacity, higher levels of genetic variation, greater resistance to herbicide control (Binová, Mandák & Pyšek 2001) and stronger competitive ability in *P. × bohemicum* compared with its progenitors, suggestive of hybrid vigour.

The phenological, morphological and chemical properties of knotweed appear to play a role in its successful invasions. It is a large herb often reaching 3 m in height, with hollow lignose stems and broad heart-shaped leaves that can create a dense and continuous canopy. Japanese knotweeds are early-seral species in their native habitats and are well suited to the colonization of disturbed sites (Seiger 1984). The species emerges early in the growing season and growth increments can reach 8 cm day⁻¹ in full sunlight (Siemens & Blossy 2007). Knotweeds can produce dense and spreading rhizome systems that extend 7 m from a source plant (Child & Wade 2000), potentially monopolizing soil water and mineral nutrients. Their bamboo-like lignose stems are slow to decompose and form a thick litter layer that may affect the performance of other species (Beering, Bailey & Conolly 1994). Knotweeds also produce potent secondary compounds that may contribute to allelopathic or antifuelling effects (Inoue et al. 1992; Beering, Bailey & Conolly 1994; Weston, Barney & DiTommaso 2005; Vrchoťová & Šera 2008; Murrell et al. 2011).

Knotweed reproduces primarily through vegetative means (rhizome or stem fragments) in its introduced range (Pyšek et al. 2003). However, generative reproduction may play a larger role in dispersal than previously assumed (Bailey, Binová & Mandák 2007; Gammon et al. 2007; Tiebre et al. 2007; Grimsby & Kessel 2010). Once introduced, knotweed can spread rapidly through the riparian zone as flood waters transport rhizome fragments and redistribute them downstream (Binová, Mandák & Pyšek 2001).

**NATIVE TREE SEEDLINGS**

Three native tree species were tested: *Alnus rubra* (red alder), *Picea sitchensis* (Sitka spruce) and *Tsuga heterophylla* (western hemlock). All are common in the study area, but play different successional roles and have differing resource requirements (Fonda 1974; Minore 1979; Van Pelt et al. 2006; Naiman et al. 2010). *Alnus* is an early-seral, shade-intolerant deciduous species that preferentially establishes on mineral substrates. It fixes atmospheric N through a symbiosis with the bacterium, *Frankia*; thus, it is relatively insensitive to variation in soil nitrogen (Hibbs, DeBell & Tarrant 1994). *Picea* is a mid-seral conifer that is moderately tolerant of shade and soil nutrient limitations. *Tsuga* is a late-seral conifer that is highly tolerant of shade, but more sensitive to below-ground competition (Christy 1986).

**STUDY SITE**

The experiment was conducted along the Dickey River (47°57' N, 124°35' W), a tributary of the lower Quillayute River on the west coast of the Olympic Peninsula (Washington, USA). The Dickey enters the Quillayute River c. 1.6 km from its estuary at the Pacific Ocean. Climate is characterized by warm summers and mild winters with consistently high relative humidity and rainfall. Annual precipitation averages 260 cm, with c. 25% falling between April and September; annual snowfall averages 38 cm. Average monthly maximum and minimum temperatures are 20.5 °C in August and 1.5 °C in December-January (climate-station data from nearby Quillayute Airport; 5.5 m elevation; 1996-2007, Western Regional Climate Center).

The Dickey River is a low gradient channel with riparian soils that are very deep, well drained, silt loams (Halloin 1987). The surrounding vegetation lies within the *Picea-Tsuga* forest zone (Franklin & Dyrness 1988). Flooding disturbance is a key determinant of community structure in these riparian forests. Fresh alluvial substrates are initially colonized by fast-growing deciduous trees, primarily *Alnus* (Fonda 1974; Van Pelt et al. 2006). *Picea* establishes subsequently and, barring repeated disturbance, *Tsuga* is able to colonize slowly. Common shrub species include *Acer circinatum, Rubus spectabilis* and *Sambucus racemosa*, and common understory herbs include *Polystichum munitum, Oxalis oregana* and *Athyrium filix-femina*.

Knotweed was the dominant invasive species at the time of this study. Nomenclature follows Hitchcock & Cronquist (1973). The study area begins c. 6 river km above the Dickey’s confluence and extends for c. 5 river km. Knotweed was introduced to the Dickey with a new foundation where it was planted as an ornamental. The Quileute tribe initiated the Dickey River knotweed removal programme in 2003 to enhance tree regeneration and improve in-stream fish habitat (Geyer 2004).

**EXPERIMENTAL DESIGN**

We used a paired removal/non-removal experiment to assess the influences of knotweed. An alternative design, pairing sites with and without knotweed, was not feasible because there were no areas lacking knotweed with comparable habitat characteristics (flood disturbance, soils, and overstory vegetation) to those with knotweed. Nine experimental blocks were established between June and September 2006 in areas of dense knotweed invasion adjacent to the river channel (0–10 m from the ordinary high-water mark). Each block was 21 x 10 m (with the long axis parallel to the stream channel), placed in a forest patch with visually homogenous overstory (canopy cover and composition) and geomorphology (slope and height above channel). Within each block, a knotweed removal treatment, knotweed (+), was randomly assigned to one half of each block and knotweed
was left intact in the other half, knotweed (+). A 1-m buffer (in which knotweed was removed) was maintained between experimental units (plots). Knotweed was removed by a Quilte Natural Resources crew using standard methods; foliage was sprayed with a glyphosate-based herbicide two to three times between June and September 2006. Although rhizome systems were not removed (to minimize soil disturbance), they were largely killed by the application of glyphosate, as evident by limited resprouting the following growing season. Glyphosate has a soil half-life of 24 days in sandy forest soils (Roy et al. 1989) and thus would have minimal effect on seedlings transplanted the following growing season. During the second growing season, herbicide was painted directly onto the leaves of any re-emerging stems to avoid non-target effects.

In April 2007, we transplanted 10 seedlings of each tree species into each plot (10 seedlings x 3 species x 2 plots/blocks x 9 blocks; 540 seedlings in total). Seedlings were spaced 0.5 m apart, 21.5 m from the back edge of each plot. Seedlings were obtained from a local nursery (Silvased Co., Roy, WA, USA) and transplanted either as P + 0 plugs (1-year-old Atnus and Tsuga) or as plug + 1s (2-year-old Picea), the stock types must often used in restoration and other planting operations in the region.

EFFECTS OF KNOTWEED ON LIGHT AVAILABILITY AND SOILS

Stem density and modal height of knotweed were measured in a 0.25 m² quadrat centred on each tree seedling. If knotweed was absent, height was assigned a value of zero. Light availability and soil physical and chemical properties were also quantified. Light availability was measured as photosynthetically active radiation (PAR; μmol m⁻² s⁻¹) in August 2007 and 2008 on clear days between 10:00 and 15:00 h. We averaged the values of three successive measurements made 0.5 m above each transplanted seedling using a sunflower spectrometer (Decagon, Inc., Pullman, WA, USA). Light availability is expressed as the proportion of ambient PAR, with ambient PAR sampled in an adjacent opening with unobstructed sky before and after measurements in each plot.

Mineral soil samples were collected between August and October 2008. Within each plot, three soil cores were extracted from the root zones of transplanted seedlings using a bulb planter (6 cm depth, 350 cm²). Bulk density (dry g cm⁻³) was determined, and a sample from each core was air-dried, sieved to 2 mm and then composited for chemical analyses. The latter were conducted as a comprehensive assessment of knotweed’s effects on soils, including pH, organic matter content (%), cation concentrations (phosphorus, potassium, magnesium, calcium, sodium; p.p.m.), cation exchange capacity (meq 100 g⁻¹), sulphate (p.p.m.), total carbon and nitrogen (%), and available nitrate (NO₃-N; p.p.m.) and ammonium (NH₄-N; p.p.m.). All analyses, except total C and N, were conducted at A & L Western Agricultural Laboratories (Modesto, CA, USA). Total C and N were determined by dry combustion using a CHN analyzer (Perkin Elmer model 2400; Waltham, MA, USA) at the University of Washington Analytical Services Center (Seattle, WA, USA).

TREE SEEDLING PERFORMANCE

Survival and growth

Survival was censused annually (August 2007 and July 2008). Initial height (cm) and basal diameter (mm) of each seedling were measured within 2 weeks of transplanting. Height was measured as stem length (root collar to leader tip). Basal diameter was measured with a calliper immediately above the root collar; for stems with elliptical cross-sections, diameter was calculated as the mean of two perpendicular measurements. Annual growth was expressed as ln(y₂ - y₀) or ln(y₂ - y₁), where y₀, y₁, and y₂ are initial, first-year and second-year heights or diameters, respectively. At each measurement, any herbivory from Roosevelt elk, beaver or insects was noted; however, there were no consistent patterns, thus herbivory was not explicitly addressed in analyses.

Ectomycorrhizal colonization and biomass allocation

A subset of surviving seedlings (n = 234, average of 12 per plot) was harvested in September 2008 to assess ectomycorrhizal colonization (ECM) of root tips (Tsuga and Picea) and biomass allocation to shoot and root systems (all species). To quantify ECM, we refrigerated seedlings for ≤ 2 weeks, maintaining root moisture during storage. We selected 20 to 40 Picea and Tsuga seedlings from each plot and gently rinsed the roots to remove soil. The entire root system was placed on a sampling grid, and three random (0.10 0.12 g) sections of fine roots were selected for analysis. We restricted sampling to roots that had grown into field soil. Sections were placed in 9-cm Petri dishes with a sampling grid and examined under a dissecting microscope (10-40x magnification). Root tips were classified as ectomycorrhizal, non-ectomycorrhizal, broken or dead. Tips were considered to be mycorrhizal unless they exhibited several to many root hairs, sloughing epidermal cells, lack of a fungal mantle, a non-swollen appearance, a clearly visible root stele and lack of a horty net (Brandrett et al. 1996; Walker et al. 1999). For the latter, we examined longitudinal sections of root tips mounted on slides in a lacte-glycerol solution (100 mL lactic acid, 100 mL distilled water and 100 mL glycerol). Dead root tips were blackened, wrinkled, cracked and easily fragmented. ECM colonization was expressed as a proportion of the total number of non-broken root tips.

To quantify biomass allocation, harvested seedlings (33 Atnus, 86 Tsuga and 103 Picea) were oven-dried at 50 °C for 5-7 days, separated into roots vs. stems and leaves (shoots) and weighed to the nearest 0.001 g.

ANALYSES

Differences in knotweed density and height, light availability (proportion of ambient PAR), and soil characteristics were compared between knotweed (+) and (−) treatments using paired t-tests (n = 9). Analyses were conducted in R ver. 2.12.1 (R Development Core Team 2010).

We evaluated eight measures of tree seedling performance: survival; height and diameter growth; total, shoot and root biomass; root/shoot ratio; and ECM colonization of root tips (cumulative only). General linear mixed models (GLMM; McCulloch, Searle & Neuhaus 2008) were used to test the effects of knotweed treatment, tree species and their interaction on each measure of performance (means for each plot). Block was treated as a random factor. Separate models were run for first- (2007) and second-year (2008) responses. Seedling survival was analysed with a binary regression and logistic link (McCulloch & Nelder 1989). Other measures of performance were analysed using a normal distribution and either an identity (height and diameter growth) or log-link (biomass, ECM colonization) error structure. For each response variable, we plotted the observed vs. expected values and applied the log-link error structure as needed to stabilize the error variance (McCulloch & Nelder 1989).

Due to complete Tsuga mortality in some knotweed (+) plots and root damage during storage, sample sizes were reduced for the analysis.
of ECM colonization \((n = 6\) for Tsuga and 8 for Picea). For models in which there was a significant species or species \(\times\) treatment interaction, we conducted a series of post hoc comparisons. To simplify the number of comparisons, pairwise comparison among species were made using GLMMs on relative performance, that is, difference in performance between treatments. Comparisons for root/shoot ratio could not be made in this way and were conducted separately within each treatment.

Preliminary analyses revealed significant variation in light availability and tree seedling survival within knotweed (+) plots. To determine whether species responded to this variation (reflecting differing light requirements), we conducted GLMMs for each species (binary regression with logit link). Individual survival in the second growing season (2008) was used as the response variable, and light (proportion of ambient PAR) and plot were included as fixed and random factors, respectively. GLMMs were conducted in SPSS ver. 19.0 (SPSS Inc. 2011).

**Results**

**EFFECTS OF KNOTWEED ON LIGHT AVAILABILITY AND SOILS**

As expected, the removal treatment resulted in significant (>90%) reductions in the density and height of knotweed (Table 1). Light availability (proportion of ambient PAR) was significantly lower (>85%) in knotweed (+) plots. Soil pH was significantly lower and total C and N significantly greater in knotweed (+) plots, although the differences in means were very small (Table 2). Soil bulk density was significantly (24%) lower in knotweed (+) plots. No other measure of soil fertility differed between treatments (Table 2).

**EFFECTS OF KNOTWEED ON TREE SEEDLING PERFORMANCE**

Tree seedling survival was markedly reduced in the presence of knotweed; however, the strength of this effect varied among species (significant treatment \(\times\) species interaction; Fig. 1a,b; Table 3). Alnus experienced significantly greater mortality than Picea and Tsuga. By the end of the second growing season, Alnus suffered complete mortality in six of nine knotweed (+) plots (vs. zero of nine knotweed (-) plots). As with survival, seedling height growth was greatly reduced in the presence of knotweed. Effects were similar among species in 2007 but differed in 2008 (significant treatment \(\times\) species interaction) (Fig. 1c,d; Table 3). Among seedlings that survived to 2008, reductions in height growth were significantly greater in Tsuga (122%) and Picea (75%) than in Alnus (which increased by 60%) (Fig. 1d). Seedling diameter growth was also reduced significantly in the presence of knotweed (Fig. 1e,f; Table 3). Reductions were greater in Alnus (78%) than in Picea (64%) or Tsuga (55%) in the first growing season (significant treatment \(\times\) species interaction; Fig. 1e), but were comparable in the second (Fig. 1f).

Measures of seedling biomass (total, root, and shoot) were greatly reduced in the presence of knotweed, but the effect did not differ among species (Fig. 2a–c; Table 3). However, patterns of biomass allocation (root/shoot ratio) differed among species in the presence of knotweed (significant treatment \(\times\) species interaction; Fig. 2d; Table 3). Knotweed had no effect on allocation in Alnus and Picea, but caused significantly greater allocation to roots in Tsuga.

Knotweed had a strong effect on ECM colonization of Tsuga (64% reduction), but not of Picea (significant treatment \(\times\) species interaction; Fig. 3; Table 3).

**TREE SEEDLING SURVIVAL VS. LIGHT AVAILABILITY**

Within knotweed (+) plots, seedling survival varied with light availability for Alnus (significance of PAR, \(P < 0.025\)) and Picea \((P < 0.01)\), but not for Tsuga \((P < 0.90)\). Light levels above surviving Alnus averaged 19%, but only 7–8% above surviving Picea and Tsuga (Fig. 4; Table 3). Mean PAR was significantly greater for live than for dead Picea, but no different for live and dead Tsuga.

**Discussion**

The results of our experiment suggest that displacement of native species by strong invaders can occur through multiple mechanisms depending on the functional traits of the resident species. Knotweed invasion of Pacific Northwestern riparian forests alters light availability and below-ground environments, differentially affecting the performance of early- to late-seral tree species in ways that are consistent with their ecophysiology. The less shade-tolerant early- and mid-seral species were sensitive to reductions in light. However, the shade-tolerant late-seral species was not. Instead, it exhibited

**Table 1.** Density and height of knotweed and light transmittance in knotweed (+) and knotweed (-) plots in the first (2007) and second (2008) growing seasons after treatment. T-statistics and \(P\) values are from paired \(t\)-tests \((n = 9)\)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Knotweed (+)</th>
<th>Knotweed (-)</th>
<th>Mean</th>
<th>SE</th>
<th>Min.</th>
<th>Max.</th>
<th>Mean</th>
<th>SE</th>
<th>Min.</th>
<th>Max.</th>
<th>(t)</th>
<th>(P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knotweed density (stems m(^{-2}))</td>
<td>18.3 ± 1.5</td>
<td>11.6 ± 2.1</td>
<td></td>
<td></td>
<td>0.1</td>
<td>10.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Knotweed modal height (cm)</td>
<td>123.3 ± 22.3</td>
<td>68.6 ± 21.1</td>
<td>8.1</td>
<td>2.0</td>
<td>0.5</td>
<td>15.3</td>
<td>5.3</td>
<td>&lt;0.004</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion of ambient photosynthetically active radiation</td>
<td>0.1 ± 0.04</td>
<td>&lt;1 ± 0.4</td>
<td>0.5</td>
<td>0.1</td>
<td>&lt;0.1</td>
<td>0.9</td>
<td>3.4</td>
<td>0.009</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Soil properties in knotweed (+) and knotweed (−) plots two growing seasons after treatment (2008). T-statistics and P values are from paired t-tests (n = 9).

<table>
<thead>
<tr>
<th>Soil parameter</th>
<th>Knotweed (+)</th>
<th>Knotweed (−)</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SE</td>
<td>Min-Max.</td>
<td>Mean</td>
</tr>
<tr>
<td>Bulk density (g cm(^{-3}))</td>
<td>0.68</td>
<td>0.04</td>
<td>0.5-0.8</td>
<td>0.9</td>
</tr>
<tr>
<td>pH</td>
<td>5.12</td>
<td>0.05</td>
<td>4.9-5.3</td>
<td>5.21</td>
</tr>
<tr>
<td>Total carbon (%)</td>
<td>2.08</td>
<td>0.1</td>
<td>1.6-2.5</td>
<td>1.67</td>
</tr>
<tr>
<td>Total nitrogen (%)</td>
<td>0.12</td>
<td>0.01</td>
<td>0.09-0.2</td>
<td>0.10</td>
</tr>
<tr>
<td>Organic matter (%)</td>
<td>3.02</td>
<td>0.2</td>
<td>2.2-3.9</td>
<td>3.03</td>
</tr>
<tr>
<td>P (ppm.)</td>
<td>8.67</td>
<td>1.1</td>
<td>4-14</td>
<td>8.56</td>
</tr>
<tr>
<td>P (NaHCO(_3)-P ppm.)</td>
<td>36.36</td>
<td>3.1</td>
<td>20-52</td>
<td>30.89</td>
</tr>
<tr>
<td>K (ppm.)</td>
<td>82.11</td>
<td>5.9</td>
<td>61-109</td>
<td>67.11</td>
</tr>
<tr>
<td>Mg (ppm.)</td>
<td>185.89</td>
<td>13.8</td>
<td>120-241</td>
<td>192.67</td>
</tr>
<tr>
<td>Ca (ppm.)</td>
<td>936.0</td>
<td>59.0</td>
<td>697-1196</td>
<td>1018.11</td>
</tr>
<tr>
<td>Na (ppm.)</td>
<td>21.78</td>
<td>1.5</td>
<td>16-29</td>
<td>23.33</td>
</tr>
<tr>
<td>CEC (meq 100 g(^{-1}))</td>
<td>10.33</td>
<td>0.6</td>
<td>7.7-12.7</td>
<td>10.56</td>
</tr>
<tr>
<td>NO(_3)-N (ppm.)</td>
<td>11.6</td>
<td>1.4</td>
<td>8-20</td>
<td>9.0</td>
</tr>
<tr>
<td>NH(_4)-N (ppm.)</td>
<td>2.4</td>
<td>0.2</td>
<td>2-3</td>
<td>2.56</td>
</tr>
<tr>
<td>SO(_4)-S (ppm.)</td>
<td>7.9</td>
<td>0.9</td>
<td>5-13</td>
<td>9.67</td>
</tr>
</tbody>
</table>

reduced ectomycorrhizal colonization and increased root/shoot ratio, suggesting a disruption of soil mutualisms by knotweed.

The breadth of knotweed effects – spanning early- to late-seral dominants – has profound implications for the structural development of riparian forests. In the presence of knotweed, rates of tree establishment and growth are greatly reduced, with the potential to alter the ecological functioning of terrestrial and aquatic habitats.

EFFECTS OF KNOTWEED ON LIGHT AVAILABILITY AND SOILS

Light is a key determinant of riparian forest composition and structure. PAR was reduced to 6-7% of ambient levels beneath knotweed. Data on light transmission from comparable, non-invaded riparian communities in the Pacific Northwest are limited. However, estimates from the understories of coastal hardwood forests in British Columbia are considerably higher – 10.8 ± 10% (Drewer 2005) and 16 ± 2% (Roburn 2003) – suggesting that knotweed has a negative effect on understory light relative to uninvas ed habitats (Siemens & Blows 2007).

We detected significant, but small differences between treatments in a number of soil properties. Soil bulk density showed the largest change, increasing 24% after knotweed removal. It is likely that decay of the dense and extensive systems of rhizomes (Child & Wade 2000) resulted in loss of macropore space. Nevertheless, bulk density values in the presence or absence of knotweed (both < 1.0) were well below levels detrimental to root growth (Minore, Smith & Woolard 1969; Kozlowski 1999) and were within the range of values documented for riparian soils in the western United States (Wheeler et al. 2002; Latterell et al. 2006) and New Zealand (Cooper, Smith & Smith 1995). Thus, it is unlikely that effects of knotweed on soil physical structure are important in shaping tree seedling responses. Although the effects on soil pH, total C and total N were statistically significant, they were small and are unlikely to be ecologically meaningful. Small differences in total N are consistent with observations in knotweed's adventive range in Europe and eastern North America. Across a wide range of European sites (including some similar to ours), Dassonville et al. (2011) found slightly lower soil pH, but no difference in total C or total N in plots with and without knotweed. However, they did find a difference in denitrification enzyme activity and a significant site x treatment interaction in ammonium (AOEA) and nitrite oxidizing enzyme activity (NOEA), suggesting spatial variation in the effects of knotweed on soils. Knotweed has also been associated with increases in soil cation and P concentrations in other systems (Vanderhoeven, Dassonville & Meerts 2005; Dassonville et al. 2007).

Although removal of knotweed had minimal effect on measures of soil chemistry in this system, our understanding of the dynamics of soil resource availability was constrained by the static nature of our measurements. It is possible that in-situ measurements of N cycling could have yielded stronger differences. It is also possible that major floods during the course of the study redistributed soils throughout the riparian corridor, masking the effects of knotweed. Finally, we did not measure differences in soil moisture availability and cannot eliminate its potential influence on seedling survival or growth. However, the study system is characterized by high relative humidity and abundant (including summer) rainfall (260 cm year\(^{-1}\)) owing to its proximity (< 2 km) to the Pacific Ocean. Moisture limitation in the presence of knotweed appears to be a much less plausible explanation for any treatment effects.

KNOTWEED-TREE SEEDLING INTERACTIONS

_Abies rubra_ is an archetypal early-seral species, adapted to disturbed environments, intolerant of shade and capable of rapid
Fig. 1. Survival (a, b), ln height growth (c, d) and ln diameter growth (e, f) for *Alnus viridis*, *Picea stichensis* and *Tsuga heterophylla* seedlings in the first (2007) and second (2008) growing seasons in the presence and absence of knotweed. Values are means (±1 SE). *P* values are from general linear mixed models (GLMM) with treatment (T), species (S) and treatment × species interaction (T × S) as fixed factors, and block as a random factor (see Table 3 for d.f. and *F* statistics). ns indicates a non-significant (*P > 0.05*) main effect or interaction. For significant treatment × species interactions, letter codes for species (A, P, T) indicate results of post hoc comparisons of relative performance.

juvenile growth. Moreover, its ability to fix atmospheric N makes it less sensitive to variation in soil resources than other riparian species (Hibbs, DeBell & Tarrant 1994). Among the tree species in this study, *Alnus* was most similar to knotweed in its functional traits (seral status, shade tolerance and leaf longevity). Consistent with trait-based theories of plant competition (Tilman 1988; Bengtsson, Fagerström & Rydin 1994), *Alnus* exhibited the strongest response to the presence of knotweed, with survivorship reduced by 83% (vs. 24–28% in *Tsuga* and *Picea*).

Several lines of evidence suggest that light limitation beneath knotweed explains the greater mortality of *Alnus*. Pezeshki & Hinckley (1982) note that *Alnus* requires levels of PAR > 80 μmol m⁻² s⁻¹ to survive; mean PAR beneath knotweed was only 14 μmol m⁻² s⁻¹ in the second growing season, far below this threshold. Second, in the presence of knotweed, light transmittance was significantly (79%) higher above live than dead *Alnus* seedlings, suggesting that survivors were growing in gaps in the knotweed canopy. Finally, height and diameter growth of surviving *Alnus* were similar between treatments suggesting an ability to maintain growth in patches of higher light, even in the presence of knotweed.

*Picea stichensis* is a moderately shade-tolerant, mid-seral dominant in these riparian forests (Fonda 1974; Minore 1979; Van Pelt et al. 2006). Although it showed the highest survival, it was not immune to the influence of knotweed. Survival declined significantly in the second growing season, and height and diameter growth were greatly reduced in the presence of knotweed. Light appeared to play a primary role in these...
Table 3. Degrees of freedom (d.f.) and $F$ statistics for models of plant performance. Values are from general linear mixed models (GLMM) with treatment, species and treatment $\times$ species interaction as fixed factors, and block as a random factor; or single species models for the knotweed (+) treatments with proportion photosynthetically active radiation (PAR) as a fixed factor and block as a random factor. See Figs 1–3 for $P$ values.

<table>
<thead>
<tr>
<th>Response variable</th>
<th>Total Model</th>
<th>Treatment</th>
<th>Species</th>
<th>Treatment $\times$ Species</th>
<th>Proportion PAR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multiple species models</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007 survival</td>
<td>5.48 17.3</td>
<td>1.48 0.01</td>
<td>2.48 6.7</td>
<td>2.48 8.1</td>
<td></td>
</tr>
<tr>
<td>2008 survival</td>
<td>5.48 15.7</td>
<td>1.48 0.06</td>
<td>2.48 12.3</td>
<td>2.48 8.2</td>
<td></td>
</tr>
<tr>
<td>2007 ln height growth (cm)</td>
<td>5.46 15.0</td>
<td>1.46 32.7</td>
<td>2.46 16.1</td>
<td>2.46 2.7</td>
<td></td>
</tr>
<tr>
<td>2008 ln height growth (cm)</td>
<td>5.40 15.0</td>
<td>1.40 22.1</td>
<td>2.40 2.2</td>
<td>2.40 6.6</td>
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</tr>
<tr>
<td>2007 ln diameter growth (cm)</td>
<td>5.46 25.7</td>
<td>1.46 82.2</td>
<td>2.46 12.9</td>
<td>2.46 6.2</td>
<td></td>
</tr>
<tr>
<td>2008 ln diameter growth (cm)</td>
<td>5.40 7.4</td>
<td>1.40 24.7</td>
<td>2.40 2.7</td>
<td>2.40 0.4</td>
<td></td>
</tr>
<tr>
<td>Total biomass (g)</td>
<td>5.36 66.2</td>
<td>1.36 24.2</td>
<td>2.36 13.4</td>
<td>2.36 0.8</td>
<td></td>
</tr>
<tr>
<td>Shoot biomass (g)</td>
<td>5.36 31.5</td>
<td>1.36 11.0</td>
<td>2.36 10.4</td>
<td>2.36 0.5</td>
<td></td>
</tr>
<tr>
<td>Root biomass (g)</td>
<td>5.36 37.5</td>
<td>1.36 12.4</td>
<td>2.36 11.7</td>
<td>2.36 0.6</td>
<td></td>
</tr>
<tr>
<td>Root/shoot biomass</td>
<td>5.36 5.8</td>
<td>1.36 1.0</td>
<td>2.36 3.1</td>
<td>2.36 5.9</td>
<td></td>
</tr>
<tr>
<td>Ectomycorrhizal % colonization</td>
<td>3.20 4.7</td>
<td>1.20 5.3</td>
<td>2.20 14.0</td>
<td>1.20 6.4</td>
<td></td>
</tr>
<tr>
<td><strong>Single species models</strong></td>
<td></td>
<td></td>
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<tr>
<td><em>Alnus</em> survival</td>
<td></td>
<td></td>
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<td></td>
<td>1.88 10.0</td>
</tr>
<tr>
<td><em>Picea</em> survival</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.88 6.9</td>
</tr>
<tr>
<td><em>Tsuga</em> survival</td>
<td></td>
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<td></td>
<td></td>
<td>1.88 0.9</td>
</tr>
</tbody>
</table>

Fig. 2. Total, shoot and root biomass (a–c), and root/shoot ratio (d) for *Alnus rubra*, *Picea stichensis* and *Tsuga heterophylla* seedlings at the end of the second growing season (2008) in the presence and absence of knotweed. Values are means (± SE). $P$ values are from general linear mixed models (GLMM) with treatment (T), species (S) and treatment $\times$ species interaction (T $\times$ S) as fixed factors, and block as a random factor (see Table 3 for d.f. and $F$ statistics). ns indicates a non-significant ($P > 0.05$) main effect or interaction. For significant treatment $\times$ species interactions, results of post hoc comparisons of means are presented above each treatment pair.

responses. In knotweed (+) plots, PAR was 79% higher above live than dead seedlings.

*Tsuga heterophylla* is a highly shade-tolerant, late-seral species. Similar to *Alnus* and *Picea*, survival and growth were greatly reduced by knotweed, but not in response to reduced light. In the presence of knotweed, levels of PAR did not differ above live and dead seedlings. Previous studies confirm that *Tsuga* can tolerate PAR as low as 3% (Carter & Klinka 1992).
Fig. 3. Ectomycorrhizal (ECM) colonization in *Picea sitchensis* and *Tsuga heterophylla* seedlings at the end of the second growing season (2008) in the presence and absence of knotweed. Values are means (+1 SE). *P* values are from general linear mixed models (GLMM) with treatment (T), species (S) and treatment × species interaction (T × S) as fixed factors, and block as a random factor (see Table 3 for d.f. and *F* statistics).

Fig. 4. Light availability [proportion of ambient photosynthetically active radiation (PAR)] above live and dead seedlings of *Alnus rubra*, *Picea sitchensis*, and *Tsuga heterophylla* in the presence of knotweed. Values are means (+1 SE). Light was measured above a total of 90 seedlings/species (10 per plot). Numbers of live seedlings are *Alnus* (*n* = 8), *Picea* (*n* = 65), *Tsuga* (*n* = 51). *P* values are from GLMM binary regression predicting survival of each species as a function of PAR (fixed factor), and plot (random factor); see Table 3 for d.f. and *F* statistics.

similar to (or lower than) values measured below knotweed in this experiment. On the other hand, *Tsuga* appears more sensitive to competition for below-ground resources (Christy 1986). In this study, several measures of *Tsuga* performance suggest that below-ground interactions with knotweed may be responsible for reductions in survival and growth. First, ECM colonization of surviving *Tsuga* was dramatically reduced (64% lower) in the presence of knotweed. Second, the root/shoot ratio of survivors was significantly greater in the presence of knotweed, a pattern not observed for *Alnus* or *Picea*. Greater allocation to root biomass may be a compensatory response to reductions in nutrient availability (which we did not observe) or to mycorrhizal density (Harley & Smith 1983; Perry *et al.* 1989). We assume that non-surviving seedlings (whose root systems and biomass allocation were not assessed) experienced similar, if not greater reductions in ECM colonization and growth, leading to eventual mortality. Responses in *Tsuga* thus appear to provide the first direct evidence of a reduction in mycorrhizal colonization of a native species attributable to the presence of knotweed. Although we did not test for the presence of root exudates, previous studies demonstrate that knotweed can produce antimicrobial and antifungal substances (Konstantinidou-Doltsinis & Schmit 1998; Kumagai *et al.* 2005), and suggest that chemical interference may contribute to its dominance of neighbouring species (Siemens & Blossey 2007; Vrchotová & Šerá 2008; Murrell *et al.* 2011). A similar strategy for disrupting soil mutualisms via secondary compounds has been documented in other exotic invaders (Marler, Zabinski & Callaway 1999; Stinson *et al.* 2006; Callaway *et al.* 2008). In this system, it is not clear why this effect was limited to *Tsuga*. It may be a physiological consequence of inherently slower growth in shade-tolerant *Tsuga*, particularly in the presence of knotweed. Alternatively, it may be attributable to differences in mycorrhizal morphotypes (Kropp & Trappe 1982) and their susceptibility to allelochemical or antifungal compounds produced by knotweed. Additional studies are needed to confirm the presence of these exudates and to understand the nature and specificity of their effects.

**Conclusion**

The success of strong invaders has often been ascribed to functional differences between invader and resident species (Elton 1958; Duelli 2003; Levine *et al.* 2003; MacDougall, Gilbert & Levine 2009). However, few, if any, studies have explicitly tested the mechanisms of interaction between strong invaders and resident species with differing functional traits (Ortega & Pearson 2005). In this study, we assessed the performance (mortality, growth and biomass allocation) of early- to late-seral tree seedlings in the presence and absence of knotweed and inferred the mechanisms of control from the correlation between species’ performance and changes in light and below-ground resources.

Knotweed can impose strong controls on the growth and survival of seedlings of the dominant tree species in this riparian system; however, the mechanisms of control vary with the resource requirements of the resident species. Suppression of early- and mid-seral species with limited shade tolerance was correlated with reductions in understory light, but suppression of a late-seral, shade-tolerant species was manifested below-ground through disruption of a critical plant mutualism that reduced ectomycorrhizal colonization of root systems. The mechanisms of interaction thus appear to reflect the breadth of resource or biotic alteration by the invader and the resources that are most limiting to species with differing functional traits.

In this system, the success of knotweed appears to reflect it dual abilities to compete for light and disrupt mycorrhizal mutualisms. Theory typically attributes successful invasions
to species' abilities to competitively exploit (Tilman 1988; Levine et al. 2003; Maron & Marler 2008) or interfere with limiting resources through 'novel weapons' (Callaway & Aschehoug 2000; Callaway et al. 2008). A small, but growing body of theory (Amarasekare 2002) and empirical evidence (Human & Gordon 1996; Ridenour & Callaway 2001; Cipollini, McClain & Cipollini 2008) relates the success of strong invaders to the combined effects of resource exploitation and interference. For example, Centaurea maculosa can develop monotypic stands that displace native grassland species through a combination of resource competition and root-mediated allelopathy (Ridenour & Callaway 2001). Similarly, widespread invasion of forest understoreys by Allaria petiolata reflects both successful competition for light and allelopathic effects (Cipollini, McClain & Cipollini 2008). The combined effect of exploitation and interference for exotic invasions has also been demonstrated in non-plant systems. Successful invasion of the Argentine ant, Linepithema humile, reflects its superiority in both resource exploitation and aggressive interference (Human & Gordon 1996). Ours is the first study to demonstrate the broader ecological consequences of these traits — reducing the survival and growth of co-occurring native tree species with differing resource requirements and seral roles. Additional work is needed to broaden our understanding of the ecological contexts and competitive or inhibitory mechanisms that lead to success in strong invaders.

Acknowledgements

Funding was provided by the Murdoch Charitable Trust and the US National Park Service. Regina Rochefort, Peter Dammwicke, Jennifer Ruesick, members of the Halber lab, and two anonymous reviewers provided valuable comments on earlier drafts of this manuscript. We are grateful to Frank Geyer and the Quilene Department of Natural Resources for help with establishing the experimental treatments. We thank Alaine Sommargren, Patrick Sowers and Deborah Oaks for assistance in the field and laboratory work.

References

(Fallopia x boehmerica, Polygonaceae). American Journal of Botany, 94, 776–783.
SPSS Inc. (2011) SPSS for Windows version 19.0. SPSS Inc, Chicago, IL.

Received: 28 October 2011; accepted: 15 May 2012
Handling Editor: Frank Gillam

Following are my comments on the proposed updates to the Critical Areas Ordinance:

I recently received a mailing from the Farm Bureau, how they want to stir up opposition to the Critical Areas Ordinance. I think it is important that you know the Farm Bureau does not speak for all farmers in our county.

I am a farmer and I believe that property rights do not include the right to fill wetlands, contaminate the soil, or build in floodplains. The public has the right not to bear the cost of private actions that harm public resources. I am proud of our efforts to protect Critical Areas and I commend our elected officials for their efforts to protect the natural resources we all enjoy and depend upon.

Thank You,

Alan Wald
6943 Woodard Bay Road NE
Olympia, WA
Re: Typing Corrections

Good Day Mr Deffobis:

I was in attendance at the start of the CAO hearing this past Saturday. Unfortunately my number was #99 and I was unable to remain in attendance for the length of time required for my opportunity to speak. I left the meeting to quickly dash-off my comments and returned to submit them in person. Now reviewing what I wrote 2 days later, I see that there are several typing errors that leave some of my perspective a touch unclear. I have changed the text only slightly from its original submission and would ask that you please exchange this text as it is more readable.

Thank you. Eli Sterling

Comment Submission

From:

Signee: #99

Eli Sterling

5541 Boston Harbor RD NE

Olympia, WA 98506

Dear County Commissioners:

Thank you for the continued and substantial efforts you have made on behalf of our County's quality of life.
I was in attendance at the start of the CAO hearing this morning. Unfortunately my number was #99 and I was unable to remain in attendance for the length of time required for my opportunity to speak.

Please recognize that I am firmly in favor of the updated CAO.

After listening for nearly 3 hours of testimony, I must admit I remain undaunted by the dismissive and volatile tone present by those opposed to these updates and ask that you please do not use the manner of these presentations as a factor (positive or negative) in your decision making process.

I ask that you hold to the functional needs of this County to maintain a quality of life that is reflective of, and dependent upon, a clean and healthy groundwater retention system.

I do have 2 comments that I would like to offer on the testimony I heard.

- I appreciated the comment of "co-labor" with homeowners. I believe this would be an effective inclusion with regard to onsite visits.

- I would like to submit that we have not been at this for seven years. In my own personal experience, we have been at this very issue for twenty-four years, since 1988. As a county and a state, citizens have spoken since that time about the need to advance our environmental regulations in a gradual manner as a means to avoiding the inevitable polarization if we were to wait until the last moment. This is exactly why we are updating the CAO this very day. Indeed, the updates reflect the collective voice of a citizenship that has been guiding the protection of our environmental future for years. There can be no winning with continued postponement - only more inevitable whining as regulations fall on the backs of fewer and fewer. I ask that you continue to move forward in advancing a safe and healthy quality of life for Thurston County.

Specifically:

A strong CAO for the County is important for the health of the ecosystem. Thank you for an excellent service in producing a much improved draft Critical Areas Ordinance. I support the following recommendations:

- Need wide buffers, especially for the marine shorelines. Science tells us that the buffers should be
up to 1000 feet wide.

- Clearing and Grading should be prohibited in all riparian habitat buffers and conditionally allowed in management zones.

- Shoreline armoring language should promote soft over hard armoring.

- More use of enforcement, education, incentives (through expansion of the open space tax benefit program) should be included.

- The wetlands buffers are good and in accordance with Department of Ecology recommendations

Thank you,

Eli Sterling

Olympia, Washington
I am a member of the League of Women Voters and I support the GAO.

Helen B Wilson Peterson
803 Cooper Point Loop SW Unit A
Olympia, WA 98502
From: Doreen Milward <DoreenMilward@cushmanlaw.com>
To: "davisj@co.thurston.wa.us" <davisj@co.thurston.wa.us>
CC: "deffoba@co.thurston.wa.us" <deffoba@co.thurston.wa.us>
Date: 06/25/2012 8:04 PM
Subject: Additional email comment for CAO update record
Attachments: DM Ltr to BOCC 2012-06-23.pdf

Jeremy,

In follow up to our conversation after the end of Saturday’s public hearing, I am sending you a copy of my comment letter. I delivered the original into a box at the hearing, and am copying Andrew with it too in this email just to be sure. I would also like this email to be considered an additional comment for the record for the BOCC’s extended public comment period.

You and I had been talking about the Ruckelshaus report and the amendments added to the GMA in 2010-11 at RCW 36.70A.560, et seq. I stated that the GMA does not regulate existing non-commercial agriculture because (1) continuation of an existing and ongoing activity is not "development", and (2) non-commercial agriculture is not defined as "agriculture" under GMA, and thus didn't believe the new voluntary stewardship requirements should have to apply to existing non-commercial agriculture. I believe you stated that the new amendments at the end Chapter 36.70A apply to all agriculture.

I have now taken a closer look at the new GMA amendments and reviewed what I think is the referenced Ruckelshaus Report "A Framework for Stewardship" Oct. 2010 [let me know if this is not it], and I now believe the RCW 36.70A.700 et seq. amendments in 2011 do encompass non-commercial as "agricultural activities" in this new section only. However, this same new section specifically exempts existing agriculture from having to comply with any regulations that are in addition to those currently in place, and there is no requirement for existing agriculture to be part of a "voluntary" stewardship program. The Ruckelshaus Report provides the framework for developing a stewardship program, but such program would not regulate existing agriculture activities. Admittedly, the statutes are not consistently clear, but the following explains how I navigated through them:

* The 2010 amendments at RCW 36.70A.560(3) and RCW 36.70A.5601 (the Ruckelshaus Center examination report) define what "agricultural activities" are in these two sections: "currently existing or legally allowed on rural land (e.g., the RR and RRR lands in Thurston County) or agricultural land designated under RCW 36.70A.170". Unlike the definition of "Agriculture" at 36.70A.030 which excludes non-commercial AG, this "agricultural activities" description does not distinguish between commercial and non-commercial.

* In 2011, a new section of Chapter 36.70A was adopted that has its own definitions just for 36.70A.700-760 - see the preface at 36.70A.703, whereby the term "agricultural activities" is not the one defined at 36.70A.560(3), but rather RCW 90.58.065 [yes, I know that's a shoreline statute from 2002, but that is what it says at 36.70A.703(1)]. "Agricultural Activities" as defined by RCW 90.58.065 also does not distinguish between commercial and non-commercial (which means it thereby encompasses both).

* While the purpose and intent verbiage at 36.70A.700 say the 2011 amendments are to establish the Ruckelshaus stewardship program ... to protect and enhance [doesn't say restore] critical areas where agricultural activities are conducted, but there are exemptions noted in 36.70A.702.

* Per RCW 36.70A.702: "Nothing in RCW 36.70A.700 through 36.70A.760 may be construed to: ... (2) require an agricultural operator to discontinue agricultural activities legally existing before July 22, 2011; ... (4) Grant counties or state agencies additional authority to regulate critical areas on lands used for agricultural activities..."

RCW 36.70A.702 is a confusing one, because if you just glance at it in the text, it appears that it is granting counties additional authority to regulate, but actually it is prohibiting the granting of additional authority. To me, these two subsections mean, at a minimum, that existing agriculture, be it commercial...
or non-commercial, can continue to operate without being subject to additional regulations imposed after July 22, 2011, including being exempt from the stewardship plan requirements at 36.70A.705, et seq.

Thurston County's CAO Update definitions for "agriculture" need to be corrected. I don't know how it would fit in the whole scheme, but perhaps you could use the definitions at 90.58.065(2)(a) - (d) which are activity-based definitions rather than the version currently proposed which applies only to commercial agriculture, or, retain the existing agriculture definitions in your present Code. I noticed the County's attorney Jeff Fancher attended the hearing, I assume in a capacity to advise the BOCC and staff. You might want to forward my comment letters to him and get his take on this.

Thank you.

Doreen Milward

Week-day contact info:
Tel: 360/534-9183
dmilward@cushmanlaw.com
June 23, 2012

Thurston County
Board of County Commissioners
2000 Lakeridge Dr SW
Olympia, WA 98502

RE: Proposed Amendments to Critical Areas Ordinance
Comments submitted at 6/23/12 Public Hearing

Dear County Commissioners:

I have many concerns about the changes being proposed for our Critical Areas Ordinance (CAO). I am familiar with the existing CAO and have read much of what is being proposed to change. Overall, I am opposed to the revisions, as the regulations greatly exceed what is necessary and thereby do not fulfill the stated purpose to: “regulate how development and redevelopment can safely occur on lands that contain critical areas” (quote taken from Thurston County’s Critical Areas Update page). I am going to focus my examples of this on just a few areas of the CAO:

Existing and Ongoing Non-commercial Agriculture.
First off, despite the direct statement in the public notice and on the front page of the revised draft for Chapter 17.15 which state how existing and ongoing agriculture in critical areas/buffers will not be regulated under the new Chapter Title 24, this is not true for NON-commercial agriculture. The definitions for agriculture in TCC 24.03 say to see TCC 17.15.200 as amended. The amended 17.15.200 definition excludes anything but commercial agriculture in the definition of “agriculture”. This means all non-commercial agriculture in critical areas/buffers will, by default, have to be regulated by Title 24 since non-commercial agriculture is not defined as “agriculture” under the new 17.15.

Putting aside the fact that the public notice for this hearing and the notice statement on the front of the draft 17.15 regulations have made misleading statements, the far worse result if these regulations are implemented, is it will put an end to most small hobby farms in the RRR zones. There is no grandfather clause in the current proposal for existing and ongoing non-commercial agriculture in critical areas/buffers. Although the provisions in proposed Chapter 24.50 would encompass farm structures, nothing is said about the ability to continue an agricultural use, such as grazing, on lands that are, and/or will now become regulated as critical areas (due to the overall increase in critical area lands – for instance, Type 5 stream buffers will increase from 25’ to 100’ and small wetlands are now to be regulated). These regulations will result in a disastrous loss to the many people who have horses, llamas, or others who raise their own livestock so we know where our food comes from.
The continuation of existing and ongoing non-commercial agriculture is not “development” or “redevelopment” under the Growth Management Act or per the County’s purpose statement for updating its Critical Areas Ordinance. Therefore, regulating existing and ongoing non-commercial agriculture under the Title 24 Regulations exceeds the stated purpose for the CAO amendment.

Furthermore, regulating (a/k/a prohibiting - which unfortunately is what would happen under Title 24) existing and ongoing non-commercial agriculture would amount to a restoration of land to pre-development conditions. This is not a requirement of GMA either, and thus is not the task that is before the BOCC, and also greatly exceeds the County’s stated purpose to “regulate how development and redevelopment can safely occur on lands that contain critical areas”. While some people may want restoration as a goal, such an undertaking is not properly brought through over-regulation across the backs of those citizens living in unincorporated Thurston County who have hobby farms.

Steep Slope/Landslide Hazard Area Buffers.
Under Chapter 24.15, there is no longer a provision to reduce the buffers under a variance, as allowed under the existing Code. The reasonable use exception standards by which such a reduction might be allowed are far more limited and could not apply, for instance, to an accessory building that is not “necessary”. Moreover, the way the proposed Code is currently drafted, it overrides what a geotechnical professional might determine to be a suitable buffer. For example, if the professional determined that a safe buffer for the slope and the structure to be built on the site could safely be setback 15 feet, the expert opinion would not matter, since per the proposed Code the buffer would still need to the “greater of” the various calculations, defaulting to 50 feet. The draft regulations identify they were considered under Best Available Science, but when an applicant hires an expert to identify a safe setback for the specific structure to be built on a specific site, and the County ignores that expert and applies its own boilerplate regulations, then the County is not applying Best Available Science, it is applying NO science.

Also realize that not all structures have equal structural impacts – a small one-story shop, for instance, would not have the same weight-bearing load as a two-story residence. There are site-specific criteria that an applicant should be able to have considered, with the County deferring to the geotechnical professional’s judgment. (See: Mason County’s CAO for landslide areas which requires a 50’ buffer OR as recommended by a geotechnical professional (not the “greater of”), MCC 8.52.140(4)(f). Lewis County has a similar provision at LCC 17.35.920(5)(f). In Clark County, a geotechnical study can supersede the standard buffers, CCC 40.430.030.D.3. In Whatcom County the size of a landslide hazard buffer is based on findings of a qualified professional, WCC 16.16.335.)

Non-Fish-Bearing Type 5 Streams.
The proposal for buffers to non-fish-bearing Type 5 streams (which dry up in the summer), to increase the buffers from 25 feet to 100 feet is dumbfounding. In many cases, these “streams” were originally created as irrigation ditches. You can step across them in the winter, and you can barely find them in the summer. I have diligently searched the County’s website for the Best Available Science that supports this 200% increase, but it appears shrouded in mystery. What I
do find keeps recirculating back to the same reports by Knutson and Neaf, 1997 which dealt with streams in forests, and Brennan, 2009 which addresses marine riparian areas. Other authorities have acknowledged that farmed streams/ditches do not have the same functions and values as forested and marine areas, why can’t Thurston County acknowledge this? Again, the stated scope of the CAO amendment is to address safe development of critical areas, not restoration of critical areas. The criteria for adopting Best Available Science to determine appropriate stream buffers should be based on the science that applies to the circumstance.

The Solution
There is an easy fix. Counties have the discretion to enact regulations that fit their jurisdictions. You do not have to adopt regulations that do nothing to “regulate how development and redevelopment can safely occur on lands that contain critical areas” (i.e., your stated purpose for revising the CAO). Existing and ongoing non-commercial agriculture is not “development” and thus should be fully defined, addressed, and incorporated into Chapter 17.15, not Title 24. For landslide buffers discussed in Chapter 24.15, if an applicant’s expert evaluates the specific project at the specific site and determines a safe buffer is less than the standard buffer, the County should defer to the professional’s judgment of what is safe – that is Best Available Science. As for increasing the Type 5 stream buffers from 25’ to 100’ feet, there is something inherently wrong with requiring a 200-foot wide undisturbed swath (100-feet on each side) to “protect” a 4-foot wide ditch. Please use reason. The GMA-required review of critical area development regulations is not intended as a backdoor method to restore the environment to pre-development conditions. If the BOCC wants to embark on a County-wide environmental restoration project, there are better ways to do it than to over-regulate only the unincorporated Thurston County residents who will be subject to these new rules.

Sincerely,

Doreen Milward
Dear Thurston County Commissioners,

Thanks for all you do! I was at the Critical Areas Ordinance hearing last weekend, but didn't have a chance to speak. The three of you did a great job (under very challenging circumstances) - kudos!

I appreciate all you are doing to protect endangered and threatened species. In particular, I have a special interest in protection of the Garry Oak habitat.

I believe British Columbia and other jurisdictions have enacted strict measures to protect the Garry Oak habitat. For example, jurisdictions around Victoria BC and southern Vancouver Island have put in place special measures to protect that ecosystem. I have visited the area and read some of their extensive literature on that topic. It is a very special and unique ecosystem, and one that deserves protection from numerous threats.

Thanks again!

Hal Stockbridge
Olympia WA
Dear Mr. Deffobis,

I am writing to support the county's efforts to update the CAO. I support all of those recommendations listed below, but my personal interest is to for sure support the buffers for marine shorelines. But beyond that, I believe it is almost more critical to keep and enlarge the buffers around fresh water streams and rivers. Please stand strong for the health of our county, the Sound and we creatures that depend on these waters.

- Need wide buffers, especially for the marine shorelines. Science tells us that the buffers should be up to 1000 feet wide.
- Clearing and Grading should be prohibited in all riparian habitat buffers and conditionally allowed in management zones.
- Shoreline armoring language should promote soft over hard armoring.
- More use of enforcement, education, incentives (through expansion of the open space tax benefit program) should be included.
- The wetlands buffers are good and in accordance with Department of Ecology recommendations

Thank you.

Robert L. Ahlschwede
3726 Wesley Loop NW
Olympia, WA 98502
Dear County Commissioners,

"I support the efforts by the County Commissioners to protect our resources with the Critical Areas Ordinance. Thank you." I received this email to pass on, to you. The thing is I really DO support the Critical Areas Ordinance. We own several properties and want very much to protect them and all of Thurston County from destructive development. Please do not listen to the negative and uniformed voices. **Protect our critical areas.**

Clara Jacobson
2628 113th Way SW
Olympia, WA 98512
June 26, 2012

Memo to County Commissioners
c/o Mr. Andrew Deffobis

Dear Mr. Deffobis and colleagues,

*It makes perfect, urgent sense for our community to embrace the Critical Areas Ordinance.* We laud your undertaking---your careful research, thoughtful vision, and clear explanation to the public.

It's shameful that, for some, 'property rights of the individual' trumps any effort to protect our natural resources. We need to keep our "eyes on the prize": a sane healthy environment for the good of all.

A tough job you've signed up for. And we urge you to keep on! Thank you so very, very much.

Sincerely,

Sandra Lewis Nisbet
920 East Bay Drive NE, 1D-301
Olympia WA 98506
360-866-1830 land-line

support the efforts by the County Commissioners to protect our resources with the Critical Areas Ordinance. Thank you.

They need name and home address. The note should go to:

"Andrew Deffobis" <deffoba@co.thurston.wa.us>,
Sandra Lewis Nisbet
smalworld@aol.com
Andrew Deffobis - Critical areas ordinance

From: s sharpes <swsharpes@yahoo.com>
To: "deffob@co.thurston.wa.us" <deffob@co.thurston.wa.us>
Date: 06/26/2012 2:21 PM
Subject: Critical areas ordinance

I support the efforts by the County Commissioners to protect our resources with the Critical Areas Ordinance. Thank you.

Shauna Sharpes
14545 Tilley Rd S
Tenino WA 98589
From: "Brian Offord" <brian.offord@comcast.net>
To: <deffoba@co.thurston.wa.us>
Date: 06/26/2012 4:05 PM
Subject: Proposed Revisions to Critical Area Ordinance
Attachments: Ltr to Thurston County re proposed revisions to Critical Area Ordinance.pdf

Andrew -

Attached are my comments to the proposed revisions of Thurston County's Critical Area Ordinance.

Please enter my comments into the record, and forward a copy to the three addresses, County Commissioners Wolfe, Romero and Valenzuela.

Thank you.

Brian Offord
Thurston County Resident and Voter
June 23, 2012

TO: Thurston County Commissioners

Regarding Proposed Revisions to Critical Area Ordinance

I congratulate the county on undertaking this long overdue review and comprehensive revision of the existing Critical Area Ordinance (CAO).

We oppose the revisions currently proposed. Their general direction is to extend the reach of the existing ordinance to include uses and new areas. This is ill-considered and ill-conceived. The proposed ordinance will have excessive and unsustainable impacts on uses of the land and the rights of owners. It selectively places undue emphasis on a few issues named in the Growth Management Act; and fails to strike a balance between all named uses as Thurston County conveniently ignores the rest. Accordingly the proposed ordinance is inconsistent with the GMA.

We support revisions that will contract the scope and adverse impact of the existing ordinance.

The existing ordinance severely and unacceptably constrains the use of properties we own.

- A 16 acre horse farm with wetland on three sides. Because of buffers and setbacks required by the ordinance, we are precluded from using our land for anything other than this historic purpose.
- A 2 acre forested upland lot zoned for residential use with wetlands on one side. Because of buffers and setbacks required by the ordinance, we are precluded from building a house and using the land as our home which was our original intent.
- Two lots, totaling 16 acres, zoned for residential use and having a lake waterfront that are 100% wetland. Because of the ordinance we are precluded from using that land for any purpose.
- Three lots developed and zoned commercial that are estuary waterfront. Because of buffers, setbacks and other restrictions imposed by the ordinance and other statutes, anything we do of almost any kind requires difficult-to-get county permits.

The proposed revisions would intensify these already-too-severe restrictions, to the even greater detriment of us as land owners, business operators who use our land, and/or county residents who patronize and/or earn a living from those businesses.

The existing ordinance deters and defeats our voluntary good faith efforts to protect sensitive natural environments.

- Modify existing operations to include best management practices. Buffer and setback restrictions led to pre-permitting indicator of “thumbs down” on a proposal that we and county staff agreed would result in a strongly beneficial net gain to critical areas.
• Modify existing structures in support of best management practices. Exorbitant permit fees, which the county refused to waive, precluded submission of a proposal strongly beneficial to critical areas.

The proposed revisions would only intensify these deterrents to conscientious citizen action.

The CAO is skewed to the extreme. In its proposed form, the CAO provides 542 pages of protection to the natural environment. I am still waiting for Thurston County to write even one page that is protective of the business environment on which we all depend.

Only one page is needed to protect private property rights, and it has already been written, by We the People. The U.S. constitution, as amended by Article V of the Bill of Rights, prohibits the taking of private property for public use without just compensation. That prohibition is mirrored by the Washington State constitution. While the CAO allows us to retain title and the responsibilities of ownership, it denies us the rights of use, for public use, e.g., to protect aquifers, without providing just compensation. The CAO as it exists now, and as it is proposed, violates constitutional law.

Continuing, Amendment XIV of the U.S. constitution, which was ratified by the State of Washington, prohibits any state from making or enforcing any law that abridges the rights and privileges guaranteed to its citizens. Included are those rights pertaining to property ownership and protection from governmental taking without just compensation. Thurston County wrongly construes it is compelled by the state, via the GMA, to take the rights of property owners.

Finally, our federal and state constitutions require governments to be representative of We, the People, from whom all government derives authority. Having observed today's public hearing, it is abundantly clear that local residents overwhelming oppose the proposed CAO, resisting protections for the environment until Thurston County puts other measures into place that are equally protective of property rights, commerce and land use. If you approve the proposed revisions, you do so against the wishes of those you represent, acting instead out of personal conscience or for personal gain.

What then differentiates between you and a dictator?

Brian Offord
Dear Commissioners,

I support the efforts by the County Commissioners to protect our resources with the Critical Areas Ordinance.

Stay strong!

Thank you so much for your stewardship.

Gratefully,

Carol Trasatto

120 State Ave NE #171

Olympia, WA 98501
Andrew Deffobis - Re: Dear Commissioner

From: Chris Gundersen <cgundersen@mac.com>
To: Andrew Deffobis <deffoba@co.thurston.wa.us>
Date: 06/26/2012 5:48 PM
Subject: Re: Dear Commissioner

Please forward this as well to the commissioner as well. Thank you!

In my last letter as seen below I could be mistaken as being in favor of the CAO in its proposed revised form. I am not in favor of the CAO. WE are in favor of being able to manage our land in a way that benefits our farm. We are good stewards of the land. We do not want the county government telling us to manage it their way when the county does not consider our farming business and private land owner needs. If you seek to manage our land without changing our tax status or seek to prevent us from adding an out building or garage because we have a gopher that is not farm management.

Additionally, Farmers are being treated just as developers are treated. We are a different entity and should be considered so. Our management is farm management not development! Please distinguish between land use for these two distinct areas.

In my below statement in the letter below "can and should be worked with the environmentalist view" I mean that we are not enemies of saving water, keeping wetlands, and protecting animals. We would like to opportunity to do so and we do on our farm, But we are not in favor of limiting our property use and farming abilities with out due course of compensation for land rendered useless in the process of an over zealous CAO and county land management.

It should be clear that county and city land management needs to be different. And that while they are different, land owners should not bear the brunt of unfair burdens concerning land use.

My example below regarding the development between Old 99, 89th, and 93rd avenue is a perfect example of mismanagement by county officials. Effectively draining a wetland into the Lott system is what happened. Is that what was intended? Because it is my understanding that the CAO is to protect the reclamation of groundwater.

Please note that Colleen Gundersen is not in favor of the CAO.

On Jun 26, 2012, at 10:26 AM, Andrew Deffobis wrote:

   Ms. Gundersen,

   Thank you for taking the time to comment. Your comments will be forwarded to the Board of County Commissioners for their consideration.

   Sincerely,

   Andrew Deffobis
Associate Planner
Thurston County Planning Department
2000 Lakeridge Drive SW
Olympia, WA 98502
Phone: (360) 786-5467
Fax: (360) 754-2939

>>> Chris Gundersen <cgundersen@mac.com> 06/23/2012 8:26 AM >>>

Dear Commissioners,

As a land owner and a family farm, Gundersen Family farms wishes to express its interest in the ordinances being considered for adoption.

Simply, I wish you to consider that stewardship of land has many facets and farming is one way to manage land that can and should be worked with the environmentalist view. We do not want to antagonize one another. As we have wetlands on our property we wish to continue farming the areas around them in such a way that is sensitive to them. We do not run our cattle directly in Salmon ditch as it is now fenced to prevent animals from entering the stream. But we have noticed that the stream is now choked with purple loose strife and filling up with other species that prevent the clear flow of water through the ditch. In the past the stream was occasionally cleared by the county or other government entity. It was kept flowing to prevent flooding as well as open waterways.

In years before people there were many changing aspects of the land and there used to be herds of elk to graze down these streams to keep them open. Now without grazing of any kind through the stream there are other man made issues. Clogged streams, back ups where there used to be clear flow and some flooding.

If your setbacks are too severe you will create wetlands that are not properly managed.

Also there are many examples of developed and man made problems with development in this county with wetlands. Take for example the development off of Oly 99 that never had homes built in it. The wetland is nearly dry in the winter there now ast the setbacks drained the water into the system set by the county toward Lott. You may recover some clean water but it will not go into the Salmon ditch. It is an example of a poorly planned area the county was trying to save as a wet land area. The opposite impact has been had.

Please listen to those who manage their own land. They know it well and want to take good care of it.

Respectfully,

Colleen Gundersen
Andrew Deffobis - Comments: Critical Areas Ordinance

From: CHRISTIE VINTILO <frogz@msn.com>
To: <deffoba@co.thurston.wa.us>
Date: 06/26/2012 6:49 PM
Subject: Comments: Critical Areas Ordinance

As a homeowner and registered voter, I am writing in support of the county commissioners' efforts to protect our county's environment and quality of life through the critical areas ordinance. I have lived my entire life in unincorporated Thurston County and I have seen firsthand how rapid growth and lack of control has changed our county, especially the rural areas, and I believe it's incredibly important that we have regulations in place to protect what we have left. While I do agree that there are some parts of the ordinance that could be modified, I think it should remain in place and any changes made individually and with great care.

Thank you,

Christie Vintilo
2616 113th Way SW
Olympia, Washington 98512
My name is Bill Hesketh,
I am an Evergreen student, state worker, and local hunter/sportsman. I am opposed to the Critical Areas Ordinance that has been proposed.

Do not encroach on our constitutional rights over a handful of noise complaints. I support my government, but these RIDICULOUS politics constantly get in the way. This is clearly not about public safety, as there has never been a concern or incident related to hunting in these areas.

Thank you for your time, I expect the right thing to be done.

Bill Hesketh
From: <webserver@co.thurston.wa.us>
To: <tcbocc@co.thurston.wa.us>
Date: 6/26/2012 11:51 PM
Subject: CAO

Please note the following: This e-mail message was generated using the Thurston County E-mail Web Application. The 'Sender Email' address in the message body is as entered by the user and may not be valid. The 'From' e-mail address in the message header cannot be replied to.

Subject: CAO

Sender Name: Gail Sheikhzadeh

Sender Email:

Sent: 6/26/2012 11:50:58 PM
Sender Message: I live in Thurston County and I support the efforts by the County Commissioners to protect our resources with the Critical Areas Ordinance. Thank you.
opposed to critical area ordinance  Marsha Gayman thurston County.
I am opposed to the Thurston county critical areas ordinance.

John Schilt
Thurston Co. resident
From: <ovrundr@comcast.net>
To: <deffoba@co.thurston.wa.us>
Date: 06/27/2012 6:07 AM
Subject: critical areas

I am opposed to the critical areas referendum.
Dave Dalton
Dear Mr. Deffobis,

I am a Thurston County property owner and I would like to express my opposition to the proposed updates to the Thurston County Critical Areas Ordinance. I believe that the proposed changes would be financially devastating to a large number of Thurston County property owners.

Thank you for taking a moment to read this note and register my opposition.

Best regards,

Janie Nelson
7139 Mullen Rd SE
Lacey, WA 98503

&
5436 40th Ave SW
Olympia, WA 98512
I write to support the efforts by our County Commissioners to protect natural resources with the Critical Areas Ordinance, preserving them for future generations. Thank you.

Stephanie Coontz
12413 Tilley Road South
Olympia, WA 98512
From: "John Hanson" <john@all-mountain.com>
To: <deffoba@co.thurston.wa.us>
Date: 06/27/2012 10:08 AM
Subject: Thurston County Critical Areas Ordinance.

Hello,
I am opposed to the Critical Areas Ordinance

Best Regards,
John Hanson
All Mountain Vacations
john@All-Mountain.com
Andrew Deffobis - Critical Areas Ordinance

From: Peta Henderson <hendersp@hotmail.com>
To: <deffoba@co.thurston.wa.us>
Date: 06/27/2012 10:26 AM
Subject: Critical Areas Ordinance

Dear Mr. Deffobis:

I support efforts by the County Commissioners to protect our resources with the Critical Areas Ordinance.

Thank you.

Peta Henderson
208 20th Ave SW
Olympia, WA 98501
From: Outdoorist <outdoorist@aol.com>
To: "deffoba@co.thurston.wa.us" <deffoba@co.thurston.wa.us>
Date: 06/27/2012 10:56 AM
Subject: Critical Ordinance

I am opposed to the critical ordinance for Thurston county and strongly urge you to vote no on this issue. It is absolutely ridiculous for property owners to lose their property rights & is unconstitutional.
Mark Engen

Sent from my iPhone
From: Mark Carlson <Mark@mdcarlson.com>
To: "deffoba@co.thurston.wa.us" <deffoba@co.thurston.wa.us>
Date: 06/27/2012 12:01 PM
Subject: Critical Areas Ordinance

Please count me as being opposed to the Critical Areas Ordinance! Mark Carlson (253) 208-9242
I urge you to reconsider the Critical Areas Ordinance. As written the ordinance is too broad and inflicts too much collateral damage on various interests. Significantly narrow the scope of the ordinance, or better yet, do not pass it at all.

Thank You,
Zeb Breuckman
From MaryAnne Herness Cottmeyer:

I have been in touch with both of you regarding my objections to this proposed regulation. I want to reiterate my objections and propose some new approaches to preserving Thurston Co. Watersheds.

My objection is that this is overkill. Your proposal takes identified & protected wetlands from 22,000 sq ft down to 1000 sq ft. Which means this goes from under 1/2 acre to .02% of an acre, and of course this does not include buffer zones arbitrarily set by the county of 50-300 ft. surrounding these supposed wetlands. This is a massive impact on rural Thurston Co. property owners.

I have the following requests:

1. I would like to know how much acreage in the county is currently protected under the existing rule. Then as a comparison, how much acreage will covered under the new rule. I believe this will show the irrationality of this proposal. This needs to be published and available to the public before any change to the current rule is adopted.

2. Before any new additions to wetlands, any impacted property owner should be notified in writing and given specifics on which watershed this effects. The county also needs to identify the soil types involved and specifically why that particular wetland is critical. This will allow each citizen to individually consider the proposal and appeal without the need to hire a county approved consultant at an exorbitant fee. This would at least allow for full disclosure and due process to each affected property owner.

3. Watersheds cross county boundaries. This is a measure that does not actually look at the whole watershed and its needs. I recommend that Watershed Commissions be set up for each watershed in Western Washington and Commissioners be elected from the citizens in that watershed. This will insure that large timber companies & state land is covered under any proposed rule. What is good for us should also apply to Weyerhaeuser & the state. They control the upper reaches of almost every watershed in Western Washington.

In speaking with Commissioner Romero's office, I got the distinct impression that this is a way to stop rural property owners from being able to develop their properties. The county already has the authority to stop inappropriate development. However, I can take you on a tour of new housing and subdivisions out in the county that were developed recently within the existing wetland designations which I believe were made effective in the 1990's. It seems those who have the money, connections or the loudest voices haven't been required to develop within the existing rules.

4. If you really want to help stop poisoning the water supply & groundwater, make Thurston Co a pesticide & weed killer free county. I'm not joking even tho Becka at Commissioner Romero's office laughed at my suggestion. This may also apply to some commerical fertilizers. A recent letter to the Editor in the Olympian was complaining about water polution in the area of College Ave & Yelm Highway. This polution is not coming from us here in the outer county, but maybe from the Capitol City Golf Course.

Master Gardeners & the County Extension Service can help making recommendations regarding the usage of pesticides, weed killers & commerical fertilizer. They actually know how these products work. There could be an exemption for some commerical farmers like Spooner Farms. I spoke with their employees and they do not currently use pesticides but they do use some commerical fertilizer. T

How many urban or suburban home owners use these products? It certainly would help the water supply if they
stopped.

5. County & State roads should meet the highest standard for pollution mitigation & natural drainage protection. Germany is an excellent example of how to build roads to protect the environment. When my parents & I tried to help the county engineers who designed the changes to Vail RD SE last year protect the natural drainage, we were ignored and they proceeded because they thought they knew better. They said they had to meet Federal Grant Requirements. I explained to them that as a retired FED, I know that grant requirements can be altered with a change order for good reasons. All this to no avail.

6. Supposedly Grays Harbor & Mason county have already adopted these new rules. Those counties are not under the same growth pressures as Thurston Co. Our biggest growth pressure in the Yelm area comes from enlarged JBLM. I'm certainly not against JBLM, but they should be contributing to relief and mitigation especially as far as road traffic and pollution is concerned. I am recommending immediate implementation of free bus service from the Yelm Area on a 1/2 hourly basis, especially during rushhours to get some of these cars off the roads and I-5. JBLM should pay for this as this is from their impact.

I personally am in favor of a light rail service to both JBLM & Olympia. This will be a hard sell as the county's reputation for fiscal management is at a disastrously low ebb because of the county jail debacle. And now taxpayers' federal taxes are going to the Nisqually Tribe for funds to build an additional correctional facility on the reservation as well.

I believe in conservation of our resources but it should be done in a smart way and with the consent of the governed. This is not happening in Thurston Co.

Please stop this disastrous regulation!!! Let's get the people impacted involved in the solution.

MaryAnne Herness Cottmeyer
14705 Lawrence Lake RD SE
Yelm, Washington 98597
PH: 360-894-1230
"Critical Area's Ordinance"
I am very "strongly opposed" to this ordinance for the simple reason that the Ordinance is constitutionally defective as it takes and/or controls private property without just compensation. It is NOT about protecting the environment or the citizens of this county it IS about control.
My vote is and will be against! NO!
Concerned citizen/tax payer and resident of Thurston county for over 21 years!
Larry M. Campbell
"Critical Area's Ordinance"
My husband and I are "strongly opposed" to this ordinance for the simple reason that the Ordinance is constitutionally defective as it takes and/or controls private property without just compensation. It is NOT about protecting the environment or the citizens of this county it IS about control.
Our vote is and will be against! NO!
Concerned citizen/tax payer and resident of Thurston county for over 21 years!
Audrey D. Campbell
audrey@camtech2000.net
We believe in protecting the environment of Thurston County. However, we believe the county is going about it the wrong way, by punishing local property owners while giving advantages to businesses.
I drink huge amounts of water and believe in protecting it. BUT, this is an absurd way. I get annoyed whenever another Walmart or WinCo come into the community, complete with their huge amounts of asphalt and traffic congestion. We don't need more. However, the small property owner, who isn't covering their whole property in asphalt or concrete, can't even build as they want. You should be more concerned about pesticides and water pollution!

Private property owners are not allowed to use their own property! The people who already commented that "the commission is making pocket gophers more important than people" are right on! It's getting out of hand. There is very little land in Thurston County that does not have pocket gophers or wetlands!

Another code that needs revision is the very little-known 5% coverage per 5-acre tract of impervious surfaces. Even though those may be critical areas for protecting our water supply, only allowing property owners to use 5% is not workable! At least 10% is more logical, and allowing for run-off from pavement to be handled on that property.

Allow the staff to work with residents to make using their property feasible! You should be more concerned about contamination from pesticides and other pollutants. Apparently that isn't nearly as much of a concern as not allowing residents to build on their own land!

One of the freedoms in America is the freedom to use our own property. Do the right thing by the citizens of the county and let us build on our own property as we need to!
Thank you,
Linda and Ron Moon
Hello -- we appreciate all of your work and efforts to create a plan to best serve our environment and planet. You have a very BIG and challenging task before you. We completely understand the need to protect the environment but believe a better approach is necessary. We just wanted to share with you that we oppose the critical areas ordinance.

People need to be educated about what the issues are regarding their specific property and the specific impacts of those issues; multiple options or solutions should be put out for consideration; property needs to be looked at on an individual basis and not a complete BLANKET... which is all encompassing of every possible little issue that particular piece of property "allegedly" has connected to it, but broken down and prioritized by the size of the various issues and then work towards creating a "reasonable and common sense" solution to the combined issues as a whole.

People, by nature, will be more open and entertaining of solution and compromise if they understand the issue, that their concerns are heard and acknowledged; and, they are a part of creating a solution,...and with that comes compromise and working together which is much more powerful and effective then trying to "strong arm" them.

Laws and regulations are creating an environment where common sense is non-existent and agencies/government have to do what the "Black and White Play Book" says even when they KNOW it doesn't make sense. It is also not right and probably not even constitutional for government to take your land and still require you to pay tax on the land they say you cannot even use and they are taking.

Thank you for taking the time to read our opinions.

Respectfully,

Ken & Teresa Trapp
Andrew Deffobis - Critical area ordinance -opposed vote

From: Angelique Choplin <angeliquepetrina@gmail.com>
To: <deffoba@co.thurston.wa.us>
Date: 06/28/2012 12:09 AM
Subject: Critical area ordinance -opposed vote

Angelique Choplin, Yelm, WA

~Angelique
I write to support the efforts by our County Commissioners to protect natural resources with the Critical Areas Ordinance, preserving them for future generations. Thank you.

Minda Concha
10411 Carney Dr SE
Olympia, WA 98501

Sent from Minda's iPad

From: Krueger, Kirk (DFW)
Sent: Thursday, June 28, 2012 10:57 AM
To: Vadas, Robert (DFW)
Subject:

It's not great, but it's a start.

Kirk L. Krueger  Ph.D.
Research Scientist
Habitat Science Team
Washington Dept. of Fish and Wildlife
1111 Washington Street SE
Olympia, WA  98501-1091

360-902-2604 (phone)
360-902-2946 (fax)
kirk.krueger@dfw.wa.gov

Science - it works.
Patterns of Surf Smelt, Hypomesus pretiosus, Intertidal Spawning Habitat Use in Puget Sound, Washington State

Timothy Quinn, Kirk Krueger, Ken Pierce, Daniel Penttila, Kurt Perry, Tiffany Hicks & Dayv Lowry

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Timothy Quinn · Kirk Krueger · Ken Pierce · Daniel Penttila · Kurt Perry · Tiffany Hicks · Dayv Lowry

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Abstract Surf smelt *Hypomesus pretiosus* are an important part of the Salish Sea food web and obligate beach spawners, yet little is known about the spatiotemporal distribution of spawning and beach characteristics related to spawning success. We counted smelt eggs at 51 sites around Camano Island, Puget Sound, Washington every 2 weeks for 1 year and at 13 of those 51 sites each month in the following year. At each site, we measured beach characteristics hypothesized to affect spawning habitat suitability as measured by egg abundance and mortality. Eggs were collected at 45 sites and pooled by month for analyses. Few sites (N=10, 19.6 %) contributed 87 % of total eggs and 89 % of all live eggs collected. Mean total egg counts at sites were higher (p<0.019) in Jul–Sep (1,790.7, SE=829.5) than in Jan–Mar (26.1, SE=10.2). Principal component and regression analyses suggested that aspect, fetch, solar radiation, and beach temperature predicted egg abundance but not mortality. Because a small proportion of sites appear to support most spawning activity, a conclusion consistent with year 2 egg counts, impacts to relatively few beaches could greatly affect surf smelt production.

Keywords Osmeridae · Forage fish · Beach spawning · Egg survival

Introduction

Marine nearshore and intertidal environments are used for spawning and early rearing by diverse fishes (Moffatt and Thomson 1978; Curseaden et al. 1997; Nakashima and Taggart 2002) and invertebrates (Brousseau et al. 2004; Jackson et al. 2005). Intertidal spawning by fish occurs on coastlines of four continents and several species representing at least six families spawn on beaches, including silverside (Atherinopsidae), killifish (Fundulidae), puffer (Tetraodontidae), smelt (Osmeridae), righteye flounders (Pleuronectidae), and stickleback (Gasterosteidae) (Penttila 1995, 2007; Martin and Swiderski 2001). The nearshore environment of the Salish Sea (Puget Sound and Georgia Basin) is spawning and rearing habitat for several fish and wildlife species (Simenstad et al. 1979; Kozlowski 1983; Kruckeberg 1991; Thuringer 2003; Townsend et al. 2006). At least three species of fish, surf smelt *Hypomesus pretiosus*, sand lance *Ammodytes hexapterus*, and rock sole *Lepidopsetta bilineata*, spawn in the intertidal zone of the Salish Sea (Schaefer 1936; Penttila 1995, 2007). Sand lance burrow into intertidal sediment during winter months (Quinn 1999), presumably as an energy conservation strategy (Winslade 1974), and Pacific herring *Clupea pallasii*, spawn on shallow subtidal macrophyton beds of the region (Gonyea et al. 1982; Penttila 1995). These species, commonly referred to as forage fish, are crucial components of marine food webs (Theriault et al. 2009) that are increasingly threatened by nearshore development from a growing human population (Penttila 2007; Anderson et al. 2009). Insufficient knowledge of the use of nearshore habitats by

T. Quinn (✉) · K. Krueger · K. Pierce · D. Penttila · K. Perry · T. Hicks · D. Lowry
Science Division, Washington Department of Fish and Wildlife Habitat Program, 600 Capitol Way N, Olympia, WA 98501, USA
e-mail: Timothy.Quinn@dfw.wa.gov

Present Address:
D. Penttila
Salish Sea Biological, 5108 Kingsway, Anacortes, WA 98221-3018, USA

Published online: 19 June 2012
forage fish limits our ability to guide development while conserving forage fish habitat.

Marine coastal areas, which comprise some of the most intensively developed landscapes throughout the world, are subjected to two frequent and important anthropogenic disturbances: shoreline armoring and removal of terrestrial vegetation (Fletcher et al. 1997; Griggs 2005; Dugan and Hubbard 2010; Krueger et al. 2010). Armoring to protect shorelines from erosion has a long history (Charlier et al. 2005), and armoring is expected to be more frequent and extensive because of rapid human populations growth near coasts (Crosett et al. 2004) and the perceived need to protect shorelines and developed areas from the effects of climate change (Scavia et al. 2002). Several recent studies in Puget Sound suggest that these disturbances can impair nearshore processes, including sediment delivery and transport and shading by riparian vegetation, which in turn affects species richness, abundance, and productivity (Romanuk and Levings 2006; Dethier and Berry 2010).

Better understanding of the spatiotemporal spawning patterns of forage fish will facilitate the conservation of their habitat as development along shorelines intensifies. We examine spatiotemporal patterns of surf smelt spawning because this species receives special protection from development, their behavior is relatively well understood, and conservation and research effort directed toward surf smelt might benefit other species. The obligate intertidal spawning behavior of surf smelt (hereafter smelt) in the Salish Sea is one of the best-documented aspects of their life history (Penttila 1995, 2007). Smelt spawn in the upper third of the tidal range in Puget Sound and appear to be tolerant of a wide range of salinities and wave energy regimes (Penttila 1978; 2001, 2002, 2007). However, recent research confirms that loss of nearshore vegetation reduces the suitability of smelt spawning habitat (Penttila 2001, 2002; Rice 2006; Rossell 2006; Lee and Levings 2007; Toft et al. 2007; Slack et al. 2010). We use suitability here to describe habitat quality, where quality can range from non-habitat to optimal habitat with maximal carrying capacity for a life stage (sensu USFWS 1981). Although smelt eggs appear to be somewhat resistant to thermal and desiccation stress, the eggs of fish spawning in summer and early fall suffer higher egg mortality on exposed beaches than on beaches with overhanging vegetation (Rice 2006; Lee and Levings 2007; Slack et al. 2010). In laboratory experiments, surf smelt eggs developed most successfully in a narrow relative humidity range (80–93 %) (Lee and Levings 2007) that on beaches is strongly dependent upon vegetative shading, sediment grain size (Penttila 2001, 2002), and both sediment and atmospheric temperature in the intertidal zone.

The effects of shoreline armoring on smelt spawning habitat is less clear, but shoreline armoring can decrease beach nourishment from eroding (feeder) bluffs and increase reflected wave energy, which lowers elevation and coarsens sediments of beaches in the upper intertidal zone (Baldwin and Lovvorn 1994; Toft et al. 2007). Spawning habitat in Puget Sound is typically found where waves and currents sort the available substrate into a sand–gravel mix with most sediment between 1 and 7 mm in diameter (Penttila 2001, 2007). Changes in the distribution of sediment to size ranges outside this window are expected to affect surf smelt spawning site selection and, perhaps, egg and larval mortality. In laboratory studies, small quantities of both suspended and settled silt were found to dramatically decrease larval smelt survival (Morgan and Levings 1989). On the other hand, Penttila (2007) suggested that most apparently suitable beaches in Puget Sound, based on substrate characteristics, do not support spawning activity, and population density, behavioral or environmental factors almost certainly also determine whether a beach supports spawning. As a result, in any given year, only approximately 30 % of the known smelt spawning beaches in Puget Sound support spawning (D. Penttila, unpublished data). While spawning seasons are coarsely known for some locations in Puget Sound; little is known about the temporal distribution of egg abundance or viability due to a lack of comprehensive temporal sampling.

The Washington Department of Fish and Wildlife (WDFW) protects fish life and habitat by administering the “Hydraulic Code” (Revised Code of Washington 77.55), which regulates work that uses, obstructs, diverts, or changes the natural flow or bed of state waters. The WDFW implements the law via the hydraulic project approval (HPA) permit process. Permits issued by the WDFW include provisions unique to the project type and physical setting that attempt to avoid, minimize, or mitigate for activities that may affect fish life in Washington’s lakes, streams, rivers, and marine environments. Given our relatively rudimentary understanding of beach spawning fish ecology, provisions to protect forage fish are typically limited to work timing windows that determine when construction activities can occur. Further, all forage fish spawning sites as determined solely by presence of eggs are currently treated equally in the permitting process and in WDFW guidance to local governments.

Our objectives were to (1) characterize the annual spatiotemporal distribution of smelt spawning over a wide variety of physical conditions in a region of Puget Sound in an effort to improve the hydraulic permitting process and technical guidance to local governments involved in development and conservation planning; (2) investigate how variation in characteristics of the beach environment affect the suitability of spawning habitat, as measured by egg abundance and mortality rates; and (3) use statistical models to quantitatively explore relationships between habitat characteristics that we postulated might dictate the suitability of
smelt spawning habitat. Finally, we conducted an exploratory analysis of interannual correlations within and among sites and the consistency of spawn abundance across years.

**Materials and Methods**

**Study Area**

Camano Island is located in Puget Sound, Washington State, between Whidbey Island and the mainland (study area; Fig. 1) and is connected to the mainland by a bridge. It has an area of approximately 103 km² and a shoreline length of approximately 84 km based on the Washington Department of Natural Resources ShoreZone inventory data (http://128.208.23.127/website/DNR_Shorezone/DNR_SZ/szdoc/sz_hdr.htm), of which 31% is armored (Puget Sound Nearshore Ecosystem Restoration Project 2009). We established 51 sampling sites along the shoreline of Camano Island (study area; Fig. 1) using a stratified random design. We selected study sites by calculating the total length of marine shoreline, excluding marshy wetland habitat along the northeast portion of the island. We excluded this habitat type because it has been consistently devoid of forage fish eggs in repeated sampling (D. Penttila, unpublished data) and because it has extensive low tide terraces composed of fine-grain sediments (silt) that are dangerous to traverse. We randomly established the first sampling site adjacent to the marsh in the first 300 m of the northeast end of the study area and, using ArcMAP (Version 9.3.1, ESRI, Redlands, CA, USA), located additional sampling sites clockwise at ~1.2 km intervals along the shoreline until we reached the northern end of the study area (Fig. 1). Sample site locations were transferred to Washington Department of Ecology oblique aerial photographs (http://apps.ecy.wa.gov/shorephotos/links.html) so that they could be located by boat using easily identifiable shore topographic features.

**Sampling Approach**

We visited all sampling sites by boat once every 2 weeks (referred to as a sample session) during each month beginning the week of 10 Sep 2007 and ending the week of 18 Aug 2008 (24 sample sessions). All sites were permanently assigned to one of three sampling routes. A two-person crew typically required 3 days to complete a sample session, with the crew sampling one route each day. We attempted to sample over consecutive days within a sample session, to space sample days between sessions as close to 12 days as possible, and to change route sampling order among sample sessions. The total number of sites sampled during a session and the sample schedule was based on logistical and ecological considerations. Sampling was performed on the lowest available daytime tides within each sample session. Given a two-person crew and the availability of suitable daytime tides, it was determined that the 51 sites could reliably be surveyed over the course of a year.

At each sampling site, we placed markers to establish two permanent, 30-m transects parallel to the waterline, one at +2.6 ± 0.2 m and the other at +3.2 ± 0.2 m above mean lower low water (MLLW). At each site, the permanent transect
elevation was determined by marking the water elevation at a specific time (during calm weather) for which tidal elevation was known. Hereafter, all beach elevations are in reference to MLLW and measured from the elevation of the two permanent transects.

Sampling for forage fish eggs consisted of taking a 500-ml scoops of surface sediment to a depth of approximately 5 cm at four locations (3, 11, 19, and 27 m) along each 30-m permanent transect (Moulton and Penttila 2001, 2006; Penttila 1995). Sediment and eggs from all subsamples for a given permanent transect were combined, transported to the laboratory, and processed on the day they were collected. Samples were processed by wet-screening them through a stacked series of sieves (4, 2, and 0.5 mm), progressively removing sediment while retaining eggs and egg-sized sediment. The remaining light fraction (fine sediment and eggs) was decanted into a washbasin, covered with 3 to 5 cm of water, and agitated to suspend lighter material, following Penttila (1995). After hydraulic winnowing, the surface 0.5–1 cm of the resulting deposit was skimmed off using a wide-mouthed sample jar. This winnowing process was repeated at least three times per sample to ensure adequate egg discovery probability (Moulton and Penttila 2001, 2006). The light fraction sub-sample was preserved in Stockard’s Solution (aqueous mix of 4% glacial acetic acid, 5% formaldehyde, and 6% glycerol). This preservative renders fish embryos opaque while leaving the yolk sac and other egg contents translucent, thus aiding in egg sample analyses. Using a dissecting microscope, eggs were identified to species, sorted into different cohort or age classes based on developmental stage, and scored as either live or dead (Penttila 1995). Live and dead eggs are treated as count data as opposed to density data since expanding them to the entire beach area would require egg distribution data that we did not collect and because we assumed that counts from standardized samples at each site were directly comparable. Our sampling method was developed based on over 30 years of sampling and analysis of more than 10,000 samples. Our previous work has shown that the collection of the top 5 cm of beach sediment collects virtually all smelt eggs and that collection, and processing of eggs on the same day as collection does not result in significant mortality.

In addition to the sampling described above, from August 2009 through July 2010, we sampled the upper permanent transect of 13 sites (sites 38–50, northwest portion of Camano Island) once per month. These sites were selected because, together, they exhibited a large range in annual egg counts during the first year of sampling. The intent of this additional sampling was to assess interannual correlations within and among sites and the consistency of high spawn abundance across years (i.e., 2007–2008 vs. 2009–2010).

Characterizing Sampling Sites

A suite of physical characteristics of all surveyed beaches were quantified once during the summer of 2009 to identify characteristics correlated with egg abundance and survival. Physical characteristics were selected based on a review of the literature describing intertidal spawning by fish and invertebrates and processes that affect the structure and function of beaches. Site-specific physical characteristics were measured in the field, whereas beach-scale physical characteristics were calculated using a geographic information system. Beach-scale physical characteristics were expected to change more slowly than, and affect the structure of, site-specific physical characteristics. We recognize that we did not measure some physical characteristics that may affect smelt spawning, but we expected to identify appropriate spatial scales and characteristics worthy of further study. At each sampling site, two temporary transects were established perpendicular to, and intersecting each end of, the 30-m permanent transect described above. Along these temporary transects, we measured beach slope between 1.3 and 3.2 m tidal elevation (Low_slope), between 3.2 m and mean higher high water (MHHW) (Mid_slope), and between MHHW and ordinary high water (OHW) (High_slope). The OHW was defined as that elevation where aquatic or semi-aquatic vegetation is replaced by terrestrial vegetation, or where terrestrial vegetation begins. At sites with no apparent physical evidence of the OHW (majority of sites), we estimated OHW to be MHHW +0.5 m. For each site, we then determined the (1) type of backshore control structure (berm, bulkhead, or bluff face); (2) elevation (Ele_control) of the toe of the bulkhead or bluff face, or in the case of a berm, the elevation of the slope break between the upper beach and berm; (3) elevation of the seaward (Ele_sea) and landward (Ele_land) edge of the driftwood zone; (4) width of the area where driftwood zone (Wood_width); and (5) volume of wood (Wood_vol) in the driftwood zone (i.e., 30 m × Wood_width). The driftwood zone was measured only where driftwood was present. Wood volume was determined during the summer of 2008 by tallying all wood pieces by 5-cm-diameter classes starting at a minimum of 10 cm at the thickest end and 60-cm-length classes starting at a minimum of 60 cm. Midpoints of diameter and length classes were used to calculate wood volumes at each site.

During the late summer period of high smelt egg abundance in 2008, additional sediment samples were collected along the upper transect at each site to evaluate beach sediment characteristics. Samples were spread out on shallow, plastic-lined trays and completely air dried in a protected alcove within a storage facility at the WDFW La Conner office. Drying typically took 3–7 days and was facilitated by gentle stirring and occasional transfer to a
sunny, undisturbed location. Dry samples were passed through a stacked series of sieves with mesh sizes of 0.1, 0.2, 0.4, 0.8, 1.7, 3.3, 6.7, 13.3, 26.7, and 53.9 mm. Material that passed through the 0.1-mm screen, which was invariably a tiny fraction of the substrate material, was retained in a shallow, solid pan. After weighing each fraction of the sample, we calculated $D_{50}$, which is the sediment size corresponding to 50% of the cumulative frequency (the median), and the graphic standard deviation of $D_{50}$ ($D_{50SD}$) in phi units, where phi refers to particle size in terms of the mesh size at which a particular fraction was retained ($\phi = -\log_2(\text{sieve mesh in mm})$).

We estimated view to sky (Vis_sky) and global site factor (GSF) at each site using hemispherical photography [Nikon Coolpix 4500 digital camera and a 180° hemispherical lens (Delta-T Devices Ltd Model SLM4)]. GSF is defined as the proportion of global solar radiation, both direct and indirect, at a given site relative to an open, unshaded location and serves as an indicator of relative exposure among sites. Photographs were taken from the center of the upper transect during late summer (after vegetation leaf out and near the presumed peak of spawning) and processed using HemiView software (Version 2.1) (Rich et al. 1999). To minimize glare from the sun, photographs were taken during early morning or late afternoon and, whenever possible, on overcast days.

Temperature was recorded hourly from 30 July 2008 to 25 August 2008 at the midpoint of the upper transect at all sites using thermographs (Stowaway TidbiT data loggers, Onset Computer Corporation). The thermograph was attached to a 0.5-m piece of rebar with a cable tie and buried in the top 5 cm of the substrate. Thermographs were checked periodically to ensure their position in the top 5 cm of sediment where temperatures are relevant to developing eggs (Penilla 1995; Slack et al. 2010). We calculated two summary statistics from these data, mean daily maximum temperatures (Max_temp) and mean daily minimum temperatures (Min_temp) at each site.

At each sampling site, several beach-scale physical characteristics that could not be measured on the beach were derived from ShoreZone data (Shaffer et al. 2007). Beach sinuosity and concavity was quantified for each site. Beach sinuosity is the ratio of the shoreline length to the straight-line length (chord) between two points on the shoreline, equidistance from, and located on either side of, the site (Fig. 2). A sinuosity of 1 indicates a long straight section of beach whereas a value of 2 indicates that the shoreline length is twice the length of the chord connecting the two points. Concavity is the distance between the midpoint of the chord to the shoreline measured at a right angle to the chord (Fig. 2). Negative values indicate an exposed beach, and positive values indicate a protected beach. Sinuosity and concavity were calculated at 500 m (Concav_500, Sinu_500) and 5,000 m (Concav_5000, Sinu_5000). These lengths were selected to help identify the spatial scales at which beach processes might affect spawning.

ShoreZone GIS data were also used to estimate beach aspect, which is defined as the normal angle (compass bearing) to the tangent line intersecting the sample site. Aspect serves as an indicator of solar exposure and has been identified as an important factor dictating the use of beaches for spawning by capelin Mallotus villosus (Nakashima and Taggart 2002). The distances from the site, along the aspect bearing, to the 10-m depth contour and to the nearest land were defined as Loc_10 and Fetch, respectively. A Short Loc_10 distance indicates a steeper nearshore slope, whereas a long length indicates a shallow slope. Aspect (in compass degrees) was converted to a standardized polar coordinate system, producing values ranging from -1 (south) to 1 (north), and redefined as Northness.

Statistical Analyses

Egg counts, including total eggs (Total_eggs), live eggs (Live_eggs), and dead eggs (Dead_eggs), were summarized by site, transect, and month to identify spatiotemporal spawning patterns and correlations with sample site characteristics. Counts were summarized by month rather than sample session because we were unable to sample all transects bi-monthly due to logistical issues (e.g., tide, inclement weather). For example, a monthly count at a site was obtained by averaging data from the bi-monthly sample sessions or by using single-visit counts where necessary for that month. Mortality rate, defined as Dead_eggs/Total_eggs, was calculated by month at each site but only when Total_eggs for that month combination was ≥10 to avoid spurious estimates. Estimating counts and mortality rate by month allowed us to derive a relatively complete data set standardized by effort across months, sites, and transects. Count and mortality data were then summarized to: (1) mean monthly site data (mean_month) calculated by summing data across all months at each site and dividing by the number of months sampled and (2) mean monthly data across all sites (mean_month), calculated by summing data across all sites each month and dividing by the number of sites sampled.

We used paired $t$ tests to compare counts of Total_eggs (mean_month) on upper versus lower transects and to compare mortality rates between upper and lower transects. Similarly, we used paired $t$ tests to compare both counts (mean_month) of Total_eggs and Live_eggs between summer July–September and winter January–March. We also calculated Pearson correlation coefficients to help understand the relationship between egg count metrics on lower versus upper transects. Only sites that had identical sampling effort (described above) were included in these comparisons. To determine if annual egg counts per site in 2008–2009 were correlated with counts in 2009–2010, we calculated the Pearson correlation coefficient between counts of upper transect Total_eggs/site on sites 38–
the structure of the candidate models to allow comparison of predictor importance as measured at the spatial extent of sites and beaches. Before conducting the analyses, we examined the data to address regression assumptions (Beaudreau and Essington 2007). We removed beach characteristics for which we were missing relatively large amounts of data because this would reduce the sample size (number of sites) of the analysis. For pairs of predictor variables that were highly correlated ($r \geq 0.7$), we eliminated one and retained the characteristic deemed most interpretable. We then constructed a model containing the following characteristics, Northness, Fetch, Concav$_{5000}$, GSF, Max_temp, Wood_vol, and $D_{30}$, followed by construction of seven nested subset models using combinations of these characteristics (see Table 2). Before running regression models, we examined scatter plots of all individual shoreline characteristics (predictor) versus egg counts (potential response variable). When plots of residuals versus fitted values indicated a non-linear relationship, we attempted to linearize the relationship by systematically applying various transformations to the predictor variable until we maximized the $r^2$ of the simple regression. We used $t$ tests to evaluate the null hypothesis that slope was equal to zero (Table 3).

The "best" models were based on corrected Akaike's information criterion (AIC$_c$), which indicates the best compromise between goodness-of-fit and model parsimony (Burnham and Anderson 2002). Models with delta AIC$_c$ less than 7 were regarded as supported by the data (Burnham and Anderson 2002, p. 70).

**Principal Component Analysis**

We conducted a principal component analysis (PCA) to condense the suite of beach characteristics measured/calculated in situ and from DNR ShoreZone data into a smaller set of compound components. We used PCA to help describe covariance patterns in beach characteristics for descriptive rather than confirmatory purposes (Tabachnick and Fidell 1989, p. 599). We hypothesized that beach characteristics were likely to respond to a few dominant environmental gradients, such as exposure to storm patterns, wave energy, and shoreform and that we could describe variation in beach characteristics in simpler ways by identifying these gradients.

Similar to the regression modeling above, we first removed variables describing surf smelt egg counts from 51 sites around Camano Island, Washington during 2007–2008.

<table>
<thead>
<tr>
<th></th>
<th>Total_eggs</th>
<th>Live_eggs</th>
<th>Dead_eggs</th>
<th>Mort_rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total_eggs</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Live_eggs</td>
<td>0.972</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dead_eggs</td>
<td>0.773</td>
<td>0.604</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>Mort_rate</td>
<td>-0.289</td>
<td>-0.345</td>
<td>-0.049</td>
<td>1.000</td>
</tr>
</tbody>
</table>

For each of the 51 beach sample sites (e.g., site A), we calculated a number of characteristics. Beach sinuosity is the ratio of the shoreline length ($B/A$) to the straight-line ($BA$) length between two points ($B$ and $A$) on the shoreline, equidistance from, and located on either side of the sample site. Concavity is the distance from the midpoint of the chord to the shoreline ($DA$ measured at a right angle to the chord. Sinuosity and concavity were determined at two scales, 500 and 5,000 m. Concavity was negative when the sample site was exposed and positive when protected (shown here). Aspect was determined at the sample site (represented here by $A$), and $Loc_{10}$ and $Fetch$ were distances measured from the sample site in the direction of $A$ to the 10-m depth contour and nearest land, respectively.

For all statistical tests, we chose $\alpha = 0.05$ (Table 1).
Table 2 Mean and range of response and predictor variables quantified in situ (site-specific) or derived from DNR ShoreZone data (beach scale)

<table>
<thead>
<tr>
<th>Name</th>
<th>Scale</th>
<th>Description</th>
<th>Units</th>
<th>Mean</th>
<th>Range</th>
<th>$r^2$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live_eggs</td>
<td>Mean</td>
<td>live eggs per month</td>
<td>Eggs/month</td>
<td>3,967</td>
<td>0–93,374</td>
<td>0.015</td>
<td>0.389</td>
</tr>
<tr>
<td>Dead_eggs</td>
<td>Mean</td>
<td>dead eggs per month</td>
<td>Eggs/month</td>
<td>2,405</td>
<td>0–21,880</td>
<td>0.213</td>
<td>0.001</td>
</tr>
<tr>
<td>Total_eggs</td>
<td>Mean</td>
<td>total eggs per month</td>
<td>Eggs/month</td>
<td>6,372</td>
<td>0–113,643</td>
<td>0.068</td>
<td>0.067</td>
</tr>
</tbody>
</table>

Predictor variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Scale</th>
<th>Description</th>
<th>Units</th>
<th>Mean</th>
<th>Range</th>
<th>$r^2$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vis_sky</td>
<td>Site</td>
<td>View to sky</td>
<td>Proportion</td>
<td>0.67</td>
<td>0.31–0.87</td>
<td>0.015</td>
<td>0.389</td>
</tr>
<tr>
<td>GSF</td>
<td>Site</td>
<td>Global site factor</td>
<td>Proportion</td>
<td>0.77</td>
<td>0.06–0.99</td>
<td>0.213</td>
<td>0.001</td>
</tr>
<tr>
<td>$D_{50}$</td>
<td>Site</td>
<td>Median sediment size</td>
<td>mm</td>
<td>6.4</td>
<td>6.6–30.3</td>
<td>0.068</td>
<td>0.067</td>
</tr>
<tr>
<td>$D_{50_SD}$</td>
<td>Site</td>
<td>Standard deviation of sediment size</td>
<td>Phi</td>
<td>2.0</td>
<td>0.6–3.9</td>
<td>0.017</td>
<td>0.364</td>
</tr>
<tr>
<td>Low_slope</td>
<td>Site</td>
<td>Slope of lower beach</td>
<td>%</td>
<td>9.6</td>
<td>3.6–15.3</td>
<td>0.255</td>
<td>0.000</td>
</tr>
<tr>
<td>Mid_slope</td>
<td>Site</td>
<td>Slope of mid beach</td>
<td>%</td>
<td>13.7</td>
<td>3.3–132.0</td>
<td>0.074</td>
<td>0.054</td>
</tr>
<tr>
<td>Ele_control</td>
<td>Site</td>
<td>Elevation of the tidal control structure</td>
<td>m</td>
<td>2.7</td>
<td>2.6–4.4</td>
<td>0.058</td>
<td>0.089</td>
</tr>
<tr>
<td>Wood_width</td>
<td>Site</td>
<td>Width of the zone where drift wood</td>
<td>m</td>
<td>4.4</td>
<td>0.3–7.9</td>
<td>0.128</td>
<td>0.010</td>
</tr>
<tr>
<td>Wood_vol</td>
<td>Site</td>
<td>Volume of drift wood</td>
<td>m³</td>
<td>6.0</td>
<td>0–77.3</td>
<td>0.012</td>
<td>0.442</td>
</tr>
<tr>
<td>Northness</td>
<td>Beach</td>
<td>Shoreline aspect: north (+1) to south</td>
<td>Index</td>
<td>-0.05</td>
<td>-0.96–0.99</td>
<td>0.574</td>
<td>0.000</td>
</tr>
<tr>
<td>Fetch</td>
<td>Beach</td>
<td>Distance to nearest land</td>
<td>m</td>
<td>6,218</td>
<td>1,692–14,446</td>
<td>0.120</td>
<td>0.013</td>
</tr>
<tr>
<td>Loc_10</td>
<td>Beach</td>
<td>Distance to depth of 10 m</td>
<td>m</td>
<td>1,303</td>
<td>66–10,599</td>
<td>0.034</td>
<td>0.194</td>
</tr>
<tr>
<td>Sinu_500</td>
<td>Beach</td>
<td>Sinuosity of 500 m segment</td>
<td>Index</td>
<td>1.0</td>
<td>1.0–1.6</td>
<td>0.022</td>
<td>0.320</td>
</tr>
<tr>
<td>Sinu_5000</td>
<td>Beach</td>
<td>Sinuosity of 5,000 m segment</td>
<td>Index</td>
<td>1.3</td>
<td>1.0–2.9</td>
<td>0.046</td>
<td>0.129</td>
</tr>
<tr>
<td>Concav_500</td>
<td>Beach</td>
<td>Concavity of 500 m segment</td>
<td>Index</td>
<td>-26.7</td>
<td>-430–229</td>
<td>0.007</td>
<td>0.569</td>
</tr>
<tr>
<td>Concav_5000</td>
<td>Beach</td>
<td>Concavity of 5,000 m segment</td>
<td>Index</td>
<td>-859</td>
<td>-4,615–3,463</td>
<td>0.000</td>
<td>0.995</td>
</tr>
<tr>
<td>Max_temp</td>
<td>Site</td>
<td>Mean of 27 max daily temps</td>
<td>°C</td>
<td>27.2</td>
<td>18.1–34.9</td>
<td>0.124</td>
<td>0.016</td>
</tr>
<tr>
<td>Min_temp</td>
<td>Site</td>
<td>Mean of 27 min daily temps</td>
<td>°C</td>
<td>18.6</td>
<td>15.5–21.5</td>
<td>0.233</td>
<td>0.001</td>
</tr>
</tbody>
</table>

We systematically applied various transformations to the predictor variable to meet normality assumptions and until we maximized the $r^2$ of the simple regression between that variable and log(Live_eggs + 1); $p$ values were based on $t$ tests to evaluate the null hypothesis that slope was equal to zero. Variables $D_{50}$, $D_{50\_SD}$, Mid_slope, Ele_control, Fetch, Loc_10, and Min_temp were log10-transformed, and Northness and Max_temp were square root transformed. Wood_vol was transformed by (SQRT(Wood_vol) + SQRT(Wood_vol + 1)).

not normally distributed, transformed variables to improve normality as determined by Lilliefors test (Systat 12). We conducted our PCA (Systat 12) using the correlation matrix of 20 beach characteristics (see Table 2 for list of variables) with no component rotation. To explore potential relationships among egg abundance and mortality rate, and principal components, we regressed log(Total_eggs + 1) and mortality rate from the upper transect at each site against each of the most important principal components. We used data from the upper transect alone because these data were more complete, i.e., included a larger number of sample sites than the lower transect data set.

Results

Sampling was occasionally curtailed due to winter weather conditions, especially at a few sites. We completed sampling during 1,131 and 1,094 of 1,224 possible site visits (51 sites×24 visits) at the upper and lower transects, respectively. When summarized by month, we sampled 607 and 592 of 612 possible site visits (51 sites×12 visits) at the upper and lower transects, respectively. By excluding December samples, we fully populated egg count data for all other site × month combinations for the upper transect. Likewise by excluding samples for December and for sites 14 and 44, we fully populated egg count data for all other site × month combinations for the lower transect.

Eggs were found at least once on 45 of 51 sites over the course of the study. The spatial distribution of egg counts around the island was clumped with about 20 % of sites contributing the vast majority of eggs (Fig. 3). Few sites ($N=10$, 19.6 %) contributed 87 and 89 % of Total_eggs and Live_eggs collected, respectively. Two relatively discrete areas of the shoreline, one on the eastern shore and another on the northwestern shore, had the highest egg abundance. Site 45 (Fig. 1) had the highest average eggs counts and over twice as many eggs as any other site. Annual counts of Total_eggs on upper transects (mean=456.7, SE=225.4) were correlated ($r=0.71$, $t_{0.05\_2\_2}=6.856$, $p<0.001$) with, but not
Table 3 Models considered in the information theoretic approach

<table>
<thead>
<tr>
<th>Model</th>
<th>Variables</th>
<th>$r^2$</th>
<th>AIC_C</th>
<th>ΔAIC_C</th>
<th>Exp(0.5 × ΔAIC_C)</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>Northness, Fetch, Concav_5000, GSF, Max_temp, Wood_vol, D_50</td>
<td>0.612</td>
<td>133.46</td>
<td>1.46</td>
<td>0.482</td>
<td>3</td>
</tr>
<tr>
<td>L2</td>
<td>Northness, Fetch, Concav_5000, GSF</td>
<td>0.611</td>
<td>138.47</td>
<td>6.47</td>
<td>0.039</td>
<td>7</td>
</tr>
<tr>
<td>L3</td>
<td>Northness, GSF, Max_temp</td>
<td>0.519</td>
<td>135.28</td>
<td>3.28</td>
<td>0.194</td>
<td>5</td>
</tr>
<tr>
<td>L4</td>
<td>Northness, Fetch, GSF, Max_temp, Wood_vol</td>
<td>0.596</td>
<td>133.10</td>
<td>1.10</td>
<td>0.578</td>
<td>2</td>
</tr>
<tr>
<td>L5</td>
<td>GSF, Max_temp, Wood_vol, D_50, Northness, Fetch, Concav_5000</td>
<td>0.612</td>
<td>133.46</td>
<td>1.46</td>
<td>0.482</td>
<td>3</td>
</tr>
<tr>
<td>L6</td>
<td>GSF, Max_temp, Wood_vol, Northness</td>
<td>0.561</td>
<td>139.48</td>
<td>1.84</td>
<td>0.371</td>
<td>4</td>
</tr>
<tr>
<td>L7</td>
<td>GSF, Wood_vol, Northness, Fetch, Concav_5000</td>
<td>0.632</td>
<td>138.44</td>
<td>6.44</td>
<td>0.040</td>
<td>6</td>
</tr>
<tr>
<td>L8</td>
<td>GSF, Max_temp, Northness, Fetch</td>
<td>0.580</td>
<td>132.00</td>
<td>N/A</td>
<td>N/A</td>
<td>1</td>
</tr>
<tr>
<td>M1</td>
<td>Northness, Fetch, Concav_5000, GSF, Max_temp, Wood_vol, D_50</td>
<td>0.024</td>
<td>51.69</td>
<td>2.95</td>
<td>0.229</td>
<td>4</td>
</tr>
<tr>
<td>M2</td>
<td>Northness, Fetch, Concav_5000, GSF</td>
<td>0.024</td>
<td>54.19</td>
<td>5.44</td>
<td>0.066</td>
<td>6</td>
</tr>
<tr>
<td>M3</td>
<td>Northness, GSF, Max_temp</td>
<td>0.011</td>
<td>48.74</td>
<td>N/A</td>
<td>N/A</td>
<td>1</td>
</tr>
<tr>
<td>M4</td>
<td>Northness, Fetch, GSF, Max_temp, Wood_vol</td>
<td>0.038</td>
<td>53.03</td>
<td>4.29</td>
<td>0.117</td>
<td>5</td>
</tr>
<tr>
<td>M5</td>
<td>GSF, Max_temp, Wood_vol, D_50, Northness, Fetch, Concav_5000</td>
<td>0.024</td>
<td>51.69</td>
<td>2.95</td>
<td>0.229</td>
<td>4</td>
</tr>
<tr>
<td>M6</td>
<td>GSF, Max_temp, Wood_vol, Northness</td>
<td>0.038</td>
<td>50.21</td>
<td>1.46</td>
<td>0.481</td>
<td>2</td>
</tr>
<tr>
<td>M7</td>
<td>GSF, Wood_vol, Northness, Fetch, Concav_5000</td>
<td>0.054</td>
<td>55.37</td>
<td>6.62</td>
<td>0.036</td>
<td>7</td>
</tr>
<tr>
<td>M8</td>
<td>GSF, Max_temp, Northness, Fetch</td>
<td>0.016</td>
<td>51.19</td>
<td>2.45</td>
<td>0.294</td>
<td>3</td>
</tr>
</tbody>
</table>

Models use either live egg (L1–8) or mortality rate (M1–8) as the response variable. AIC_C was used to determine the best model and other models in the subset were ranked for validity relative to the best model. For descriptions of variables and how they were transformed to improve normality, see Table 2.

Significantly different ($t_{0.05(2), df=48}=1.94, p<0.059$) from annual counts of Total_eggs at lower transects (mean$_{sites}=125.6, SE=35.3$). Egg counts varied seasonally, with peak abundance in late summer and early fall, though Live_eggs (albeit often in small number) were found during all months of the year at both transects (Fig. 4). Summer counts of Total_eggs (mean$_{sites}=1,790.7, SE=828.5$) were significantly higher ($t_{0.05(2), df=48}=2.13, p<0.019$) than winter counts of Total_eggs (mean$_{sites}=26.1, SE=10.2$), but summer counts of Live_eggs (mean$_{sites}=955.8, SE=632.2$) were not significantly different ($t_{0.05(2), df=48}=1.23, p=0.206$) from winter counts of Live_eggs (mean$_{sites}=43.3, SE=1.7$). Mortality rates peaked in summer at around 75% just before egg counts reached their seasonal maximum and then declined to less than 20% in late September at both transects (Fig. 4). Egg mortality rates on upper transects (mean$_{sites}=0.589, SE=0.031$) were significantly higher ($t_{0.05(2), df=33}=3.21, p=0.003$) than mortality rates at lower transects (mean$_{sites}=0.458, SE=0.031$).

Egg counts at 13 sites were fairly consistent between years. Counts of Live_eggs on upper transects in 2009–10 were correlated ($r=0.756, t_{0.05(2), df=11}=8.78, p<0.001$) with counts of Live_eggs in 2008–09 suggesting interannual stability in spawning site usage.

Regression Analyses

All potential response variables were correlated with each other, though some weakly (Table 1). Live_eggs and Total_eggs were highly correlated ($r=0.972$), but $r^2$ values for regression models were generally higher for Live_eggs; thus, we concentrated modeling efforts on Live_eggs and Dead_eggs as response variables.

Seven predictor variables (GSF, Low_slope, Wood_width, Northness, Fetch, Max_temp, Min_temp) exhibited significant linear relationships with Live_eggs, with Northness having the highest $r^2$ (0.574). Nine predictor variables had significant linear relationships with Dead_eggs including the same seven variables as Live_eggs and addition of D_50 and Sinu_5000. The best models for Live_eggs and Dead_eggs both contained GSF, Northness, and Max_temp (Tables 2 and 4). Additionally the best model for Live_eggs included Fetch. Concav_5000 and D_50 were not included in the top models for either response variable or inclusion of Wood_vol varied (Tables 2 and 4).

Principal Component Analysis

We computed eigenvectors utilizing 16 beach characteristics and retained the first three principal components for interpretation (Table 5) based on the broken stick criterion (Jackson 1993). These first three components explained 23.83, 15.01, and 10.60% of the total sample variance, respectively (Table 5). Based on the relative percent variance criterion alone, which suggests that the cumulative percent variance of the first one to three components should be greater than 70%, this PCA does not dramatically reduce the dimensionality of the beach variation. Nevertheless, each of the first three components explains significantly
of wood. Three of the 16 original variables (Loc_10, Sinu_5000, and D_10_SD) did not load on either of the first two components and apparently do not contribute to the beach site gradient. Live_Egg counts were significantly associated ($F_{1,43}=22.49, p<0.000$) with PC1 scores (Log (1+Live_egg) = $-8.50 \times $ PC1 scores + $2.20; r^2=0.34$), but not PC2 scores ($p=0.23$).

**Discussion**

We found pronounced and consistent spatiotemporal patterns of surf smelt spawning on Camano Island, and these patterns can inform improved conservation efforts. The spatial distribution of egg occurrence was highly continuous, with smelt eggs found at nearly every site sampled over the course of a year, including many beaches where previous, less-intensive sampling failed to document smelt spawning. Although surveys to detect smelt spawning have been
conducted throughout much of Puget Sound (Penttila 2007), our knowledge of spawning locations and their relative importance both intra- and inter-annually remains incomplete. Spawning beaches likely differ dramatically in production of smelt and their value for maintaining population abundance. The spatial distribution of egg abundance was nonuniform; sites on the northwestern edge of the study area (sites 42–48) contained up to several orders of magnitude more eggs than other regions of the island, a pattern that was consistent between years. This marked dominance in usage as spawning sites existed despite broad variation among these sites in some beach characteristics, including median sediment particle size, beach slope, backshore control type and height, wood band width, sinuosity, and concavity. However, in addition to being located in the northwest region of the study area, these sites were united by comparatively low maximum sediment temperatures, substantially greater fetch, narrow wood bands, and (except site 42) a north-facing beach aspect. The results of both our information theoretic approach and PCA support this overall trend toward high-use spawning beaches being characterized by medium to high potential wave action (e.g., high fetch, narrow wood bands) and low solar exposure (e.g., north facing, low GSF, lower maximum temperature).

The results of our study are consistent with studies of capelin (M. villosus), suggesting that processes affecting spawning usage are likely similar among species and locations. Use of spawning beaches by capelin, as well as egg abundance on spawning beaches, has been linked to beach aspect (orientation) and the degree of substrate size sorting in Conception Bay, Newfoundland, Canada (Nakashima and Taggart 2002; Taggart and Nakashima 1987). The dominant orientation of high-use spawning beaches was northeasterly for capelin, which matches the geophysical context of spawning beaches in the current study with respect to fetch, prevailing wave action, and solar exposure. Additionally, Nakashima and Taggart (2002) noted that sediment size profiles within a beach may change seasonally as a consequence of changes in prevailing winds and resultant wave action. We only quantified sediment profiles during summer months so the degree to which those profiles change by season, and the resultant effects on egg retention and
### Table 4: Standardized regression coefficients and p values for each independent variable describing beach characteristics used to explain live eggs counts (models L1–8) and mortality rate (models M1–8)

<table>
<thead>
<tr>
<th>Effect</th>
<th>Model L1</th>
<th>Model L2</th>
<th>Model L3</th>
<th>Model L4</th>
<th>Model L5</th>
<th>Model L6</th>
<th>Model L7</th>
<th>Model L8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northness</td>
<td>0.619</td>
<td>0.000</td>
<td>0.564</td>
<td>0.000</td>
<td>0.635</td>
<td>0.000</td>
<td>0.606</td>
<td>0.000</td>
</tr>
<tr>
<td>Fetch</td>
<td>0.248</td>
<td>0.048</td>
<td>0.288</td>
<td>0.006</td>
<td>0.211</td>
<td>0.075</td>
<td>0.248</td>
<td>0.048</td>
</tr>
<tr>
<td>Concav_5000</td>
<td>-0.192</td>
<td>0.117</td>
<td>-0.133</td>
<td>0.184</td>
<td>-0.187</td>
<td>0.121</td>
<td>-0.220</td>
<td>0.056</td>
</tr>
<tr>
<td>GSF</td>
<td>-0.205</td>
<td>0.098</td>
<td>-0.249</td>
<td>0.020</td>
<td>0.008</td>
<td>0.944</td>
<td>0.039</td>
<td>0.733</td>
</tr>
<tr>
<td>Max_temp</td>
<td>-0.018</td>
<td>0.878</td>
<td>0.143</td>
<td>0.223</td>
<td>0.144</td>
<td>0.240</td>
<td>0.215</td>
<td>0.062</td>
</tr>
<tr>
<td>Wood_vol</td>
<td>0.144</td>
<td>0.240</td>
<td>-0.032</td>
<td>0.785</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$D_{50}$</td>
<td>-0.032</td>
<td>0.785</td>
<td>0.033</td>
<td>0.876</td>
<td>0.127</td>
<td>0.455</td>
<td>0.015</td>
<td>0.934</td>
</tr>
<tr>
<td>Fetch</td>
<td>-0.020</td>
<td>0.918</td>
<td>-0.122</td>
<td>0.449</td>
<td>0.015</td>
<td>0.934</td>
<td>-0.025</td>
<td>0.900</td>
</tr>
<tr>
<td>Concav_5000</td>
<td>0.024</td>
<td>0.902</td>
<td>0.072</td>
<td>0.646</td>
<td>-0.021</td>
<td>0.908</td>
<td>-0.020</td>
<td>0.918</td>
</tr>
<tr>
<td>GSF</td>
<td>0.074</td>
<td>0.700</td>
<td>0.042</td>
<td>0.797</td>
<td>-0.021</td>
<td>0.908</td>
<td>-0.020</td>
<td>0.918</td>
</tr>
<tr>
<td>Max_temp</td>
<td>-0.079</td>
<td>0.677</td>
<td>-0.090</td>
<td>0.595</td>
<td>-0.123</td>
<td>0.482</td>
<td>-0.079</td>
<td>0.677</td>
</tr>
<tr>
<td>Wood_vol</td>
<td>-0.094</td>
<td>0.623</td>
<td>-0.166</td>
<td>0.355</td>
<td>-0.094</td>
<td>0.623</td>
<td>-0.173</td>
<td>0.300</td>
</tr>
<tr>
<td>$D_{50}$</td>
<td>-0.089</td>
<td>0.636</td>
<td>-0.089</td>
<td>0.636</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For descriptions of variables and how they were transformed to improve normality, see Table 2
Table 5  Component loadings for six principle components derived from analysis of beach attributes measured on 46 beaches around Camano Island in Puget Sound

<table>
<thead>
<tr>
<th>Beach attribute</th>
<th>PC1</th>
<th>PC2</th>
<th>PC3</th>
<th>PC4</th>
<th>PC5</th>
<th>PC6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northness</td>
<td>-0.770</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max_temp</td>
<td>0.654</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GSF</td>
<td>0.625</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ele_temp</td>
<td>0.577</td>
<td>0.462</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min_temp</td>
<td>0.577</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High_slope</td>
<td>-0.574</td>
<td></td>
<td></td>
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<td>Mid_slope</td>
<td>-0.499</td>
<td></td>
<td></td>
<td></td>
<td>0.489</td>
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<tr>
<td>Concav_500</td>
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<td>-0.475</td>
</tr>
<tr>
<td>Concav_5000</td>
<td></td>
<td></td>
<td>0.615</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fetch</td>
<td></td>
<td>0.591</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood_vol</td>
<td></td>
<td>0.580</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Sinu_500</td>
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<tr>
<td>Dso</td>
<td></td>
<td></td>
<td></td>
<td>-0.468</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loc_10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.714</td>
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</tr>
<tr>
<td>Sinu_5000</td>
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<td></td>
<td></td>
<td>0.485</td>
</tr>
<tr>
<td>Dso_SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.573</td>
</tr>
</tbody>
</table>

Loadings with absolute values < 0.45 were considered unimportant (Tabachnick and Fidell 1989) and not included here. Loadings > 0.60 are shown in bold for emphasis. For descriptions of variables and how they were transformed to improve normality, see Table 2.

viability, cannot be directly evaluated. In addition, other factors such as predation on and off the beach and larval transport and rearing undoubtedly contribute to the suitability of surf smelt spawning sites. These factors were beyond the scope of our work but clearly warrant further study.

We postulate that the suitability of a beach for spawning by smelt is due primarily to characteristics of the beach and adjacent beaches. Beach characteristics are in turn determined by sediment source, exposure, and the energy available to shape beach morphology. Wave action influences beach form through erosion, transport, and deposition of sediment and organic matter (Dugan and Hubbard 2006, 2010; Patsch and Griggs 2006). Puget Sound is populated by numerous feeder bluffs composed of glacial till that contribute sediment to beaches. Due to limitations in fetch and the predominant direction of storms relative to the north south orientation of shorelines, wave action is typically oblique to shore in Puget Sound (Finlayson 2006; Johannessen and MacLennan 2007; Shipman 2008, 2010). This geomorphic setting produces sediment drift cells along which wave action and sediment turnover are relatively stable and predictable, barring storm events and human disturbance of the shoreline. The suitability of beaches for smelt spawning is likely related to its position within a drift cell. We suggest that on beaches where wave action has sorted the sediment appropriately, water percolation and retention may be balanced such that smelt eggs in the upper intertidal remain damp but not continually immersed. Moderation of relative humidity in a narrow window (80–93 %) is critical to surf smelt egg development (Lee and Levings 2007). As the prevailing winds in Puget Sound are strong and come from the southwest in winter and weaker and northerly in summer (Overland and Walter Jr. 1983; Finlayson 2006), it is possible that beaches on southern Camano Island have, over geologic time, developed into suboptimal smelt spawning habitat through wave action (but see comments on seasonal beach reconditioning above). This is borne out in the nearly complete lack of eggs in sites 23–32 along southwest Camano Island and the prevalence of finer sediments along these beaches as compared to the high-use beaches (Dso=6.73 vs. 4.70). However, the small number of drift cells identified on Camano Island precludes meaningful statistical analysis.

The suitability of a beach for spawning by smelt is also related to its exposure to incident solar radiation, which is the greatest on south-facing beaches. As a consequence of exposure, the average temperature of intertidal sediments on south-facing beaches can, all other characteristics being equal, be expected to be higher than on north-facing beaches. Recent studies have shown that smelt egg mortality increases with increasing exposure to solar radiation, sediment temperature, and desiccation (Penttila 2001, 2002; Rice 2006; Rossell 2006; Lee and Levings 2007). These findings are consistent with the pattern of smelt egg abundance across the gradient represented by PC1. Two other lines of evidence in our data suggest that high summer temperatures and associated effects (e.g., low humidity) may be related to poorer spawning habitat suitability. First, smelt eggs at lower elevation transects generally had lower mortality rates than eggs at higher transects, although egg abundance was also lower. This suggests that thermal and desiccation stress were both minimized lower on the beach. Furthermore, egg mortality declined markedly after August at both upper and lower egg transects with the seasonal decrease in atmospheric temperature and the return of
regular precipitation. The preferred tidal height for placement of eggs at a given spawning site is likely a tradeoff between thermal and desiccation stresses at higher intertidal elevations and increased relative humidity and predation stresses at lower elevations.

Beaches are commonly armored with concrete or rock revetments to prevent erosion or to gentrify yards (Kraus and McDougall 1996; Holsman and Willig 2007; Shipman 2010). When revetments are placed within the marine intertidal zone, they can have cascading effects resulting in changes to the beach profile, coarsening of beach sediments, loss of large woody debris, and increased wave energy to the foreshore (Holsman and Willig 2007; Dethier and Berry 2010; Dugan and Hubbard 2010). Humans can also increase exposure to solar radiation of the beach as a result of clearing the land of vegetation for construction and to provide an unobstructed view of the water. The direct detrimental effects on gross habitat characteristics and microclimate, exacerbated by sea level rise as a consequence of climate change (Krueger et al. 2010), indicate that shoreline armoring and marine riparian zone elimination represent two important threats to the continued reproductive capacity of surf smelt in Puget Sound (Penttila 2007; Rice 2010).

Management Implications

The challenge of conservation is finding ways to minimize the loss of biodiversity with limited financial and human resources (Bottrill et al. 2009). Thus, natural resource managers are commonly confronted with three fundamental questions: (1) what needs protection, (2) where should it be protected, and (3) how should it be protected (Primack 2010, p. 351). While substantial scientific uncertainty remains regarding the characterization of suitability of surf smelt spawning habitat and the processes that create and maintain them, our results along with other important work on beach ecology cited herein suggest a number of immediate actions that could improve conservation of surf smelt spawning habitat. First, given the high demand for additional shoreline development and the fact that nearly 30% of Puget Sound marine shoreline and 31% of Camano Island is currently armored (Puget Sound Nearshore Ecosystem Restoration Project 2009), the most important spawning beaches should be identified and afforded more protection and restoration effort. That is, beaches in northwest Camano Island and those with low summer temperature, north-facing aspect, and relative large fetch are more important for smelt spawning than other beaches and thus should receive additional consideration during the HPA and other shoreline construction permitting processes. In addition, the drift cells in which these beaches occur should also be considered as important conservation targets, particularly in terms of maintaining sediment delivery and transport processes.

Where development will occur, armoring should be permitted only where it is critically necessary to protect capital investments and then placed above the ordinary high water mark based on future sea level rise predictions. All shoreline vegetation should be maintained, especially trees that shade the intertidal region of the beach. While spawning sites with northerly aspects may currently be more resilient to high temperatures than sites with southerly aspects, increasing sea and air temperatures associated with climate change may diminish the suitability of all beach sites.

Finally, while the value of providing best available science is clear in cases involving imminent and permanent change, such as human development of the nearshore, we also urge commitment to better use of scientific information especially where we have learned from past mistakes. For example, the importance of spawning during seasons with low egg abundance should not be discounted. Although total smelt egg abundance and the number of live eggs were the highest in summer, eggs were often found in abundance during winter when mortality was relatively low; suggesting that smelt that spawn in winter might substantially contribute to the population, at least during years or at locations when summer mortality is especially high. Conserving sufficient habitat quantity and suitability for expression of such variations in life history might facilitate species persistence in highly variable environments (Caswell 1983), or serve as locations of bet-hedging (Helfman et al. 1997), that ensure the long term survival of smelt faced with disturbance. These conservation actions might be especially important as environments become more variable due to human actions and climate change (Reed et al. 2010).

We have two concluding thoughts relative to information needs. First, given the high demand for additional shoreline development, there is a tremendous need to better understand how typical shoreline development affects beaches as smelt spawning habitat both at the site and larger (e.g., drift cell) scales. Second, although widespread surveys to detect smelt spawning have been completed throughout much of Puget Sound (Penttila 2007), our knowledge of spawning locations and their relative importance both intra- and inter-annually remains incomplete over much of Puget Sound. Failure to detect eggs in a few samples remains poor evidence of absence of smelt spawning just as relatively low abundance of eggs in a few samples at a site may not be indicative of the importance of that site over an annual cycle. We encourage a more thoughtful approach to permitting new shoreline armoring projects in Puget Sound given existing survey data. Specifically, projects with potential to affect site or drift cell characteristics should receive forage fish spawning surveys for at least 1 year similar to the surveys we conducted on Camano Island. Data from these surveys would increase the probability of avoiding false negative results and begin to test the applicability of the
Camano Island spawning suitability model outside of our study area.

Acknowledgements The authors thank the land owners of Camano Island for allowing access to their property and B. Benson for expert data management and GIS assistance. Three anonymous reviewers provided constructive comments that improved the focus and presentation of this manuscript.

References


Morgan, J.D., and C.D. Levings. 1989. Effects of suspended sediment on eggs and larvae of lingcod (Ophiodon elongatus), Pacific herring (Clupea harengus pallasi), and surf smelt (Hypomesus pretiosus). In Canadian Tilial Report of Fisheries and Aquatic Sciences. West Vancouver: Department of Fisheries and Oceans.


I could not attend the public hearing on June 23rd, 2012, as I was out of town. I did want to offer my thoughts on the Critical Areas Ordinance and some 'first' hand experience related to it. I will be forwarding these comments to local Western Washington media outlets for their ongoing knowledge on this topic.

1) As you can see from my signature, I am a Washington State Real Estate Broker and live in Rochester.

2) My main comments are in regards to the land use restrictions and/or fees associated with the 'Mazama Pocket Gopher' as it affects land we own as well as income potential for myself in real estate in Southern Thurston County.

3) I love wildlife and the outdoors, but I have found no information as the 'benefit' to the Mazama Pocket Gopher and any good reason whatsoever for affecting land values and in many cases, people's retirement $$ that may be tied up on their land that can (and has, I understand) been hit hard by this part of the Critical Areas Ordinance.

4) I have attached an article from some very noted universities. It not only does not note ANY beneficial aspects to the pocket gopher, but highlights the many 'damaging' effects it brings to the table. See yellow boxes around data (bottom of page 2 and top of page 3).

5) I would like to share some 'First Hand' experience on how this unnecessary restriction is affecting people (and Thurston County tax revenue).

   a. My wife and I have had a 5 acre parcel for sale for several months that is in the 'prairie' area of Rochester (east side of I-5).

      We have had some interest, but everyone asks about 'What will Thurston County force us to do to build on the property'?

      Even as a Real Estate Broker, I cannot answer this for them.

      In one case, we had a potential buyer, but their builder (and the buyer) got cold feet and backed out of the potential purchase due to CONCERNS over how restrictive Thurston County would be on them building on the property.

      ALL of the properties around this 5 acre parcel have houses, barns, horses, cows, etc., but they could not get an answer that would make them comfortable moving forward.

      We talked with an attorney familiar with the situation and he said
there was 'no logical' reason that Thurston County would restrict usage of the 5 acres to build on and have full use of the land, but there were no guarantees. The buyer walked away from the deal. There are many others like this.

Thurston County would get MORE taxes on the potentially improved property, which seems like something the County NEEDS???

We have had other inquiries, but NO ONE as of yet, wants to deal with the potential issues, additional costs and potential restricted use of the land.

Thurston County has our assessed value at least $20-25,000 higher than we have much of a chance to sell it at. It is a bigger 'delta' realistically with the above issues.

b. I have had a couple of real estate clients that have property in Thurston County and have asked me to look for something else for them, ANYWHERE other than Thurston County.

In summary -

1) I do not see any benefit to the Critical Areas Ordinance, especially as it relates to revenue for Thurston County, only the opposite. If people cannot improve their property or use the property as they want to, within zoning, setbacks, etc., then Thurston County does not get the additional 'improved' status taxes. What tax revenues does the Mazama Pocket Gopher bring to the county?

2) Has the county done assessments on what these and other onerous regulations are doing to restrict county taxes (which is your life blood)? I have heard of other businesses that want to leave (or have left) the county due to your 'regulations'? One prime example, as I understand is Ritchie Brothers that had to move to Lewis County. How much did this cost Thurston County in tax revenue that Lewis County was glad to accept? I am sure there are other businesses with this same concern.

Thank you for your consideration and time to read this email.

jwf - signature - transparent

John W. Ferguson, Jr. - Broker
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POCKET GOPHERS

Identification

Pocket gophers (Fig. 1) are fossorial (burrowing) rodents, so named because they have fur-lined pouches outside of the mouth, one on each side of the face (Fig. 2). These pouches, which are capable of being turned inside out, are used for carrying food. Pocket gophers are powerfully built in the forequarters and have a short neck; the head is fairly small and flattened. The forepaws are large-clawed and the lips close behind their large incisors, all marvelous adaptations to their underground existence.

Gophers have small external ears and small eyes. As sight and sound are severely limited, gophers are highly dependent on the sense of touch. The vibrissae (whiskers) on their face are very sensitive to touch and assist pocket gophers while traveling about in their dark tunnels. The tail is sparsely haired and also serves as a sensory mechanism guiding gophers’ backward movements. The tail is also important in thermoregulation, acting as a radiator.

Pocket gophers are medium-sized rodents ranging from about 5 to nearly 14 inches (13 to 36 cm) long (head and body). Adult males are larger than adult females. Their fur is very fine, soft, and highly variable in color. Colors range from nearly black to pale brown to almost white. The great variability in size and color of pocket gophers is attributed to their low dispersal rate and thus limited gene flow, resulting in adaptation to local conditions.

Thirty-four species of pocket gophers, represented by five genera, occupy the western hemisphere. In the United States there are 13 species and three genera. The major features differentiating these genera are the size of their forefeet, claws, and front surfaces of their chisel-like incisors (Fig. 3).

Thomomys have smooth-faced incisors and small forefeet with small claws. Northern pocket gophers (Thomomys talpoides) are typically from 6 1/2 to 10 inches (17 to 25 cm) long. Their fur is variable in color but is often yellowish brown with pale underparts. Botta’s (or valley) pocket gophers (Thomomys bottae) are extremely variable in size and color.

Botta’s pocket gophers are 5 inches to about 13 1/2 inches (13 to 34 cm) long. Their color varies from almost white to black.

Geomyys have two grooves on each upper incisor and large forefeet and claws. Plains pocket gophers (Geomyys bursarius) vary in length from almost 7 1/2 to 14 inches (18 to 36 cm). Their fur is typically brown but may vary to black. Desert pocket gophers (Geomyys arenarius) are always brown and vary from nearly 8 3/4 to 11 inches (22 to 28 cm) long. Texas pocket gophers (Geomyys personatus) are also brown and are from slightly larger than 8 3/4 to nearly 13 inches (22 to 34 cm) long. Southeastern pocket gophers (Geomyys pinetis) are of various shades of brown, depending on soil color.
and are from 9 to 13 1/4 inches (23 to 34 cm) long.

Pappogeomys have a single groove on each upper incisor and, like Geomys, have large feet with large claws. Yellow-faced pocket gophers (Pappogeomys castanops) vary in length from slightly more than 5 1/2 to just less than 7 1/2 inches (14 to 19 cm). Their fur color varies from pale yellow to dark reddish brown. The underparts vary from whitish to bright yellowish buff. Some hairs on the back and top of the head are dark-tipped.

**Range**

Pocket gophers are found only in the Western Hemisphere. They range from Panama in the south to Alberta in the north. With the exception of the southeastern pocket gopher, they occur throughout the western two-thirds of the United States.

Plains pocket gophers (Geomys bursarius, Fig. 4a) are found in the central plains from Canada south through Texas and Louisiana. Botta's (or valley) pocket gophers (Thomomys bottedae, Fig. 4a) are found in most of the southern half of the western United States.

Northern pocket gophers (Thomomys talpoides, Fig. 4b) range throughout most of the states in the northern half of the western United States. Yellow-faced pocket gophers (Pappogeomys castanops, Fig. 4b) occur from Mexico, along the western edge of Texas, eastern New Mexico, southeastern Colorado, southwestern Kansas, and into the panhandle of Oklahoma.

Southeastern pocket gophers (Geomys pinetis, Fig. 4c) are found in northern and central Florida, southern Georgia, and southeastern Alabama. Southern pocket gophers (Thomomys umbrinus, Fig. 4c) range primarily in Central America, but occur in extreme southwestern New Mexico and southeastern Arizona.

Desert pocket gophers (Geomys arenarius) occur only in southwestern New Mexico and the extreme western edge of Texas. Mazama pocket gophers (Thomomys mazama), mountain pocket gophers (Thomomys monticola), and Camas pocket gophers (Thomomys bulbivorus) have more limited distributions in the extreme western United States.

**Habitat**

A wide variety of habitats are occupied by pocket gophers. They occur from low coastal areas to elevations in excess of 12,000 feet (3,600 m). Pocket gophers similarly are found in a wide variety of soil types and conditions. They reach their greatest densities on friable, light-textured soils with good herbage production, especially when that vegetation has large, fleshy roots, bulbs, tubers, or other underground storage structures.

The importance of soil depth and texture to the presence or absence of gophers is both obvious and cryptic. Shallow soils may be subject to cave-ins and thus will not maintain a tunnel. Tunnels are deeper in very sandy soils where soil moisture is sufficient to maintain the integrity of the burrow. A less visible requirement is that atmospheric and exhaled gases must diffuse through the soil to and from the gopher’s tunnel. Thus light-textured, porous soils with good drainage allow for good gas exchange between the tunnel and the atmosphere. Soils that have a very high clay content or those that are continuously wet diffuse gases poorly and are unsuitable for gophers.

Pocket gophers sometimes occupy fairly rocky habitats, although those habitats generally do not have more than 10% rocks in the top 8 inches (20 cm) of soil. Pocket gophers appear to burrow around rocks greater than 1 inch (2.5 cm) in diameter, but smaller rocks are frequently pushed to the surface.

Soil depth is also important in ameliorating temperatures. Soils less than 4 inches (10 cm) deep probably are too warm during summers. Shallow tunnels may also limit the presence of gophers during cold temperatures, especially if an insulating layer of snow is absent.

Typically, only one species of pocket gopher is found in each locality. Soil factors are important in limiting the distributions of pocket gophers. The larger gophers are restricted to sandy and silty soils east of the Rockies. Smaller gophers of the genus Thomomys have a broader tolerance to various soils.

**Food Habits**

Pocket gophers feed on plants in three ways: 1) they feed on roots that they encounter when digging; 2) they may go to the surface, venturing only a body length or so from their tunnel opening to feed on aboveground vegetation; and 3) they pull vegetation into their tunnel from below. Pocket gophers eat forbs, grasses, shrubs, and trees. They are strict herbivores, and any animal material in their diet appears to result from incidental ingestion.

Alfalfa and dandelions are apparently some of the most preferred and nutritious foods for pocket gophers. Generally, Thomomys prefer perennial forbs, but they will also eat annual plants with fleshy underground storage structures. Plains pocket gophers consume primarily grasses, especially those with rhizomes, but they seem to prefer forbs when they are succulent in spring and summer.

Portions of plants consumed also vary seasonally. Gophers utilize above-ground portions of vegetation mostly during the growing season, when the vegetation is green and succulent. Height and density of vegetation at this time of year may also offer protection from predators, reducing the risk of short surface trips. Year-round, however, roots are the major food sources. Many trees and shrubs are clipped just above ground level. This occurs principally during winter under snow cover. Damage may reach as high as 10 feet (3 m) above ground. Seedlings also have their roots clipped by pocket gophers.

Several mammals are sometimes confused with pocket gophers because of variations in common local terminology (Fig. 5). In addition, in the southeastern United States, pocket gophers are called "salamanders," (derived from the term sandy mounder), while the term gopher refers to a tortoise. Pocket gophers can be distinguished from the other mammals by their telltale signs as well as by their appearance. Pocket gophers leave soil mounds on the surface of the ground. The mounds are usually fan-shaped and tunnel entrances are plugged, keeping various intruders out of burrows.

Damage caused by gophers includes destruction of underground utility cables and irrigation pipe, direct consumption and smothering of forage by earthen mounds, and change in species composition on rangelands by providing seedbeds (mounds) for invading annual plants. Gophers damage

trees by stem girdling and clipping, root pruning, and possibly root exposure caused by burrowing. Gopher mounds
dull and plug sicklebars when harvesting hay or alfalfa, and soil brought to the surface as mounds is more likely to
erode. In irrigated areas, gopher tunnels can channel water runoff, causing loss of surface irrigation water. Gopher
tunnels in ditch banks and earthen dams can weaken these structures, causing water loss by seepage and piping
through a bank or the complete loss or washout of a canal bank. The presence of gophers also increases the likelihood
of badger activity, which can also cause considerable damage.

Legal Status

Pocket gophers are not protected by federal or state law.

Control Methods

Exclusion

Because of the expense and limited practicality, exclusion is of little use. Fencing of highly valued ornamental shrubs or landscape trees may be
justified. The fence should be buried at least 18 inches (46 cm). The mesh should be small enough to exclude gophers: 1/4-inch or 1/2-inch (6- to
13-mm) hardware cloth will suffice. Cylindrical plastic netting placed over the entire seedling, including the bare root, reduces damage to newly planted
forest seedlings significantly.

Cultural Methods and Habitat Modification

These methods take advantage of knowledge of the habitat requirements of pocket gophers or their feeding behavior to reduce or eliminate damage.

Crop Varieties. In alfalfa, large tap-rooted plants may be killed or the vigor of the plant greatly reduced by pocket gophers feeding on the roots.
Varieties with several large roots rather than a single taproot suffer less when gophers feed on them. Additionally, pocket gophers in alfalfa fields with
fibrous-root systems may have smaller ranges. This would reduce gopher impact on yield.

Crop Rotation. There are many good reasons for using a crop rotation scheme, not the least of which is minimizing problems with pocket gophers.
When alfalfa is rotated with grain crops, the resultant habitat is incapable of supporting pocket gophers. The annual grains do not establish large
underground storage structures and thus there is insufficient food for pocket gophers to survive year-round.

Grain Buffer Strips. Planting 50foot (15-m) buffer strips of grass around hay fields provides unsuitable habitat around the fields and can minimize
immigration of gophers.

Weed Control. Chemical or mechanical control of forbs, which frequently have large underground storage structures, can be an effective method of
minimizing damage by Thomomys to rangelands. It may also be effective in making orchards and shelterbelts less suitable for pocket gophers. The
method is less effective for plains pocket gophers as they survive quite nicely on grasses. The warm-season prairie grasses have large root-to-stem
ratios and these food sources are adequate for Geomys.

Flood Irrigation. Irrigating fields by flooding can greatly reduce habitat suitability for pocket gophers. Water can fill a gopher's tunnel, thus causing the
occupant to drown or flee to the surface, making it vulnerable to predation. The soil may be so damp that it becomes sticky. This will foul the
poor gopher's fur and claws. As the soil becomes saturated with water, the diffusion of gases into and out of the gopher's burrow is inhibited,
creating an inhospitable environment. The effectiveness of this method can be enhanced by removing high spots in fields that may serve as refuges
during irrigation.

Damage-Resistant Plant Varieties. Tests of several provenances of ponderosa pine showed that some have natural resistance to gopher damage.

Repellents

Some predator odors have been tested as gopher repellents and show some promise. Commercially available sonic devices are claimed to repel pocket
gophers. There is, however, no scientific supporting evidence. The plants known as caper spurge, gopher purge, or mole plant (Euphorbia lathyris)
and the castor-oil plant (Ricinus communis) have been promoted as gopher repellents, but there is no evidence of their effectiveness. In addition,
these are not recommended as they are both poisonous to humans and pets.

Toxicants

Several rodenticides currently are federally registered and available for pocket gopher control. The most widely used and evaluated is strychnine
alkaloid (0.25 to 0.5% active ingredient) on grain baits. There is some concern that pocket gophers may consume sublethal doses of strychnine and
then develop bait shyness. Strychnine acts very rapidly and gophers sometimes die within an hour after consuming a lethal dose. It is registered for
use for Geomys spp. and Thomomys spp. If the label has directions for use with a burrow builder machine, then it is a Restricted Use Pesticide. Zinc
phosphide (2%) is less effective than strychnine for gopher control. Anticoagulants now are available for pocket gopher control. Currently, the only
federally registered products are chlorophacinone and diphenacrine.

To poison pocket gophers, the bait must be placed in their tunnel systems by hand or by a special machine known as a burrow builder. Underground
baiting for pocket gopher control with strychnine presents minimal hazards to nontarget wildlife, either by direct consumption of bait or by eating
poisoned gophers. Poison bait spilled on the surface of the ground may be hazardous to ground-feeding birds such as mourning doves.

The main drawback to grain baits is their high susceptibility to decomposition in the damp burrows. A new product that contains a grain mixture plus
the anticoagulant, diphenacrine, in a paraffin block not only increases the bait's effective life, but also makes it possible for more than one gopher to be
killed with the same bait. Once the resident gopher ingests the toxicant and dies, it is typical for a neighboring gopher to take over the tunnel system
and thus to ingest the still-toxic bait.

Hand Baiting. Bait can be placed in a burrow system by hand, using a special hand-operated bait dispenser probe, or by making an opening to the
burrow system with a probe. Placing bait in the burrow by hand is more time-consuming than either of the probing methods, but there is no doubt
that the bait is delivered to the tunnel system.
The key to efficient and effective use of these methods is locating the burrow system. The main burrow generally is found 12 to 18 inches (30 to 46 cm) away from the plug on the fan-shaped mounds (Fig. 6). If you use a trowel or shovel to locate the main burrow, dig 12 to 18 inches (30 to 46 cm) away from the plug. When the main burrow is located, place a rounded tablespoon (15 ml) of bait in each direction. Place the bait well into each tunnel system with a long-handled spoon and then block off each tunnel with sod clumps and soil. Bait blocks are also applied in this manner. The reason for placing the burrow is that pocket gophers are attracted to openings in their system with the intent of closing them with soil. Thus, if there is a detectable opening near the placement of poison, the pocket gopher may cover the bait with soil as it plugs the opening. Pocket gophers normally travel all portions of their burrow system during a day.

place a probe for pocket gopher tunnels where you expect to locate the main burrow as described above. shiny metal, instructions for use are presented in figure 7. you will know you have located a burrow by the decreased friction on the probe. With a reservoir-type bait probe dispenser (Fig. 8), a button is pushed from the surface of the ground to the burrow. Place about a tablespoon (15 ml) of bait down the probe opening. This method is much quicker than digging open the burrow tunnel. For best control, dose each burrow system in two or three places. Be sure to cover the probe hole with a sod clump so that the pocket gopher does not cover the bait when attracted to the opening in its burrow. greater doses of chlorophacinone or other locally registered anticoagulants are recommended (1/2 cup [120 ml]) at each of two or three places in each burrow. also, since some gophers poisoned in this manner die aboveground, the area should be checked periodically for 10 to 14 days after treatment. Any dead gophers found should be buried or incinerated.

**mechanical burrow builder.** The burrow builder (Fig. 9) delivers bait underground mechanically, so large areas can be economically treated for pocket gopher control. it is tractor-drawn and is available in hydraulically operated units or three-point hitch models.

For extensive use in relatively soft soil, a durable probe may be made of 3/4-inch gas pipe—1 piece 30 inches long. The 30-inch piece is threaded at both ends and the other pieces at one end only. A piece of 1/2-inch round iron about 2 inches long is welded into the unthreaded end of the 14-inch pipe and bluntly pointed. The pieces are then arranged and fitted together with two 3/4-inch T-joints as shown here.

For use in hard soil, the probe may be made of the following materials:

1. piece of 1/2-inch galvanized pipe, 34 inches long
2. piece of 1/2-inch galvanized pipe, 5 inches long
3. 1/2-inch galvanized T-joint
4. piece of 1/2-inch round iron, 2 inches long
5. piece of highly tempered steel, 3/8-inch in diameter and 28 inches long
6. 3/8-inch set screw, 1 inch long
7. 3/8-inch nut
8. reducer, 1/2 inch to 3/8 inch

The two pieces of pipe are each threaded at one end. The piece of round iron is welded into the unthreaded end of the 34-inch pipe and bluntly pointed. A 3/8-inch hole is bored in the T-joint, and the 3/8-inch nut is brazed over this hole to accommodate the set screw. The piece of highly tempered steel is sharply pointed on one or both ends and held in place by the set screw. The pointed end of a hayrake tooth cut 28 inches long would serve well for this piece. These materials are then assembled as shown here.

The device consists of a knife and torpedo assembly that makes the artificial burrow at desired soil depths, a couter blade that cuts roots of plants ahead of the knife, a seeder assembly for bait dispensing, and the packer wheel assembly to close the burrow behind the knife. the seeder box has a metering device for dispensing various toxic baits at desired rates.

The artificial burrows should be constructed at a depth similar to those constructed by gophers in your area. The artificial burrows may intercept the gopher burrows, or the gophers may ineffectively enter the artificial burrows, gather bait in their cheek pouches, and return to their burrow system to consume the bait. Recommended application rates of 1 to 2 pounds per acre (1.1 to 2.2 kg/ha) of 0.3 to 0.5% strychnine alkloid grain should provide an 85% to 95% reduction in the gopher population (table 1 demonstrates how to calculate bait delivery rates). The burrows should be spaced at 20- to 25-foot (6- to 8-m) intervals. To assure success:

1. Operate the burrow builder parallel to the ground surface, at a depth where gophers are active. It is essential to check the artificial burrow. If the
soil is too dry, a good burrow will not be formed; if the soil is too wet and sticky, soil will accumulate on packer wheels or even on the knife shank and the plot may not close adequately.

2. Check periodically to note whether bait is being dispensed. Sometimes the tube gets clogged with soil.

3. Encircle the perimeter of the field with artificial burrows to deter reinvasions.

4. Follow directions provided with the burrow builder machine. It is especially important to scour the torpedo assembly by pulling it through sandy soils so that smooth burrows will be constructed.

It is especially important to scour the torpedo assembly by pulling it through sandy soils so that smooth burrows will be constructed.

Table 1. Burrow builder machine bait application rate chart.

<table>
<thead>
<tr>
<th>What bait</th>
<th>Spacing between rows of suction heads (inch)</th>
<th>Baited burrow delivery per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30</td>
<td>12</td>
</tr>
<tr>
<td>Fresh, liquid bait</td>
<td>81</td>
<td>82</td>
</tr>
<tr>
<td>Fresh, solid bait</td>
<td>81</td>
<td>82</td>
</tr>
</tbody>
</table>

EXAMPLE: To determine the amount of bait that will be delivered if a mechanical baler is set to apply 0.5 pound per 1,000 feet of burrow, and is to be used between orchard rows with 22-foot spacings, read down row spacing column 22 until opposite the designated 0.5 pound. The answer (to the nearest hundredth) is 0.99 pound.

Fumigants

Federally registered fumigants include aluminum phosphide and gas cartridges with various active ingredients. These fumigants usually are not very successful in treating pocket gophers because the gas moves too slowly through the tunnel system. Unless the soil is moist, the fumigant will diffuse through the soil out of the gopher’s tunnel.

Carbon monoxide from automobile exhaust is more effective than other fumigants because of its greater volume and pressure. Connect a piece of hose or pipe to the engine exhaust, and place it in a tunnel near a fresh soil mound. Pack soil around the hose or pipe and allow the engine to run for about 3 minutes. The method is usually 90% effective. The engines of newer vehicles with antipollution devices require a longer running time since they do not produce as much carbon monoxide. This procedure requires no registration.

Trapping

Trapping is extremely effective for pocket gopher control in small areas and for removal of remaining animals after a poisoning control program. Some representative traps are illustrated on the following page (Fig. 10) with instructions for setting them (Figs. 11 and 12).

Vulnerability to trapping differs among species of pocket gophers and sometimes within the same species in different areas and at different times of the year.
Fig. 10. Common types of traps for pocket gophers.

(a) Macabee gopher trap

(b) Victor® Gopher Getter

(c) Death Clutch 1 gopher and mole trap

**Fig. 11. Instructions for setting Macabee®**

Hold trap exactly as shown. Be sure left index finger holds trigger (1) in upright position.

For effective trapping, the trap site is to find the tunnel. The procedure will vary depending on whether the traps are set in the main tunnel or the lateral tunnels. The lateral tunnels (Fig. 10) locate traps in the main tunnel or refer to the section on hand baiting. To locate lateral tunnels, find a fresh mound and with a trowel or shovel, dig into the soil away from the mound on the bank side. The lateral may be plugged with stones several inches (cm) or several feet (m). However, fresh mounds are usually plugged only a few times.

You may have to experiment with trap type and placement. Some trapsites have numerous lateral tunnels completely open when they set their traps; others, where the lateral tunnels are plugged, require the trap to be moved or replaced. The lateral to trap completely, and when trapping the lateral, trap flags and should be anchored with a stake and wire or chain a predator does not middle crank the trap.

Trapping can be done year-round because gophers are always active and a formidable effort is required for trapping when the soil is frozen. Trapping is most effective when gophers are putting up new mounds, generally in spring and fall; a trap in a mound is not effective for 48 hours. Move it to a new location. Leave traps on a tunnel system where you have trapped goffers in spring and early summer, when gophers are most likely to charge the open trap.

**Fig. 12. gopher**

Pull the clockwork from slot until it clicks. With a crook, probe toward flat flat flat flat

**Shedding**

Since pocket gophers spend essentially all their time below ground, this method is impractical.

**Other Methods**

Buried utility cables and irrigation lines can be protected by enclosing them in various materials, as long as the diameter of the cable is not more than 2.5 inches (7.4 cm). Gophers can open the mouth of the cable only 7 inches (18 cm), so using an essentially flat surface to cover the cable and a woven material over the surface is the recommended method. Materials can be good preventive measures, but they are not perfect. Soft metals such as lead and aluminum used for arming cables are readily damaged by pocket gophers if the diameters of the cables are less than the suggested sizes.

Buried cables may be protected from gopher damage by surrounding the cable with 5 to 8 inches (15 to 20 cm) of coarse gravel. Pocket gophers usually burrow around gravel 1 inch (2.5 cm) in diameter, whereas smaller pebbles may be pushed to the surface.

**Economics of Damage and Control**

Economically, only 25 to 50% of the forage lost to pocket gophers. Botta's pocket gophers at a density of 42 per acre (79/ha) decreased the forage yield by 25% on grasslands in California, where the plants were nearly all annuals. Pains pocket gophers reduced forage yield on rangelands in western Nebraska by 21% to 49% on different range sites. Alfalfa yields in eastern Nebraska were reduced as much as 46% in dryland and 35% in irrigated alfalfa. Losses of 30% have been reported for hay meadows.

Calculating the cost of control operations is only slightly more complicated. However, the benefit-cost ratio analysis of control is still not straightforward. More research data are needed on managing the recovery of forage productivity. For example, should range be fertilized, rested, or lightly grazed? Should gopher mounds on alfalfa be lightly harrowed? A study of northern pocket gopher control on range production in southern Alberta indicated that forage yields increased 16%, 3 months after treatment. The potential for complete yield recovery the first year following gopher removal has been noted for a fibrous-rooted variety of alfalfa.

Economic assessment should also be made to determine the cost of no control, the speed of pocket gopher infestation, and the costs associated with dug or plugged mowing machinery or mechanical breakdowns caused by the mounds. Assessment could also be made for damages to buried cable, irrigation structures, trees, and so on.

The benefits of pocket gophers also complicate the economic analysis. Some of these benefits are: (1) increased soil fertility by adding organic matter such as buried vegetation and fecal wastes; (2) increased soil aeration and decreased soil compaction; (3) increased water infiltration and thus increased runoff; and (4) increased rate of soil formation by bringing subsoil material to the surface of the ground, subjecting it to weathering.

Decisions on whether or not to control gophers may be influenced by the animals' benefits, which are long-term and not always readily recognized.
and the damage they cause, which is obvious and sometimes substantial in the short-term. Landowners who are currently troubled by pocket gophers can gain tremendously by studying the gophers’ basic biology. They would gain economically by learning how to manage their systems with pocket gophers in mind, and aesthetically by understanding how this interesting animal “makes a living.”

The distribution of gophers makes it unlikely that control measures will threaten them with extinction. Local eradication may be desirable and cost-effective in some small areas with high-value items. On the other hand, it may be effective to simply reduce a population. There are also times when control is not cost-effective and therefore inadvisable. Complete control may upset the long-term integrity of ecosystems in a manner that we cannot possibly predict from our current knowledge of the structure and function of those systems.

Acknowledgments

We thank the many researchers and managers who have spent untold time studying these extremely interesting rodents. Some are listed in the reference section. Special thanks are due to Scott Hygstrom for his editorial assistance; to Rex E. Marsh, Bob Timm, and Jan Hygstrom for their helpful comments on an earlier draft, and to Diane Gronewold and Diana Smith for their technical assistance.

Figures 1, 2, and 6 from Schwartz and Schwartz (1981).

Figures 3 and 5 from Turner et al. (1973).

Figures 4a, 4b, and 4c after Hegdahl and Harbour (1991), adapted by Bruce Lasch and Dave Thornhill.

Figures 7, 8, and 10 by Jill Sack Johnson.

Figure 9 courtesy of Elston Equipment Company.

Figure 11 courtesy of Z. A. Macabee Gopher Trap Company.

Figure 12 courtesy of P-W Manufacturing Company.

Figure 13 adapted from E. K. Boggess (1980), “Pocket Gophers,” in Handbook on Prevention and Control of Wildlife Damage, Kansas State University, Manhattan.

Table 1 taken from Marsh and Cummings (1977).

For Additional Information


Editors
Scott E. Hygnstrom; Robert M. Timm; Gary E. Larson

PREVENTION AND CONTROL OF WILDLIFE DAMAGE — 1994

Cooperative Extension Division Institute of Agriculture and Natural Resources University of Nebraska - Lincoln

United States Department of Agriculture Animal and Plant Health Inspection Service Animal Damage Control

Great Plains Agricultural Council Wildlife Committee
From: Maureen Canny <mocanny@comcast.net>
To: <deffoba@co.thurston.wa.us>
Date: 06/21/2012 8:15 PM
Subject: Please support a strong Thurston County CAO

Dear Mr. Deffobis,

A strong CAO for the County is important for the health of the ecosystem. Thank you for an excellent service in producing a much improved draft Critical Areas Ordinance. I support the following recommendations:

- Need wide buffers, especially for the marine shorelines. Science tells us that the buffers should be up to 1000 feet wide.
- Clearing and Grading should be prohibited in all riparian habitat buffers and conditionally allowed in management zones.
- Shoreline armoring language should promote soft over hard armoring.
- More use of enforcement, education, incentives (through expansion of the open space tax benefit program) should be included.
- The wetlands buffers are good and in accordance with Department of Ecology recommendations
- Please consider changing the Non Conforming Use Section to require a smaller footprint than the 5,000 sq. ft buildable area.

Thank you.

Maureen Canny
7848 58th Ave NE
Olympia, WA 98516
I support the proposed amendments.

John M. Gray
5021 Laura St. S.E.
Olympia, WA 98501
(360) 754-0757
From: Susan Mac <susanshaf@comcast.net>
To: <deffoba@co.thurston.wa.us>
Date: 06/21/2012 8:21 PM
Subject: CAO Comments

Thank you all for the hard work you have been doing!
I am very much in-support of the CAO plans and my only concern is that the SMA is equally as restrictive of development as the CAO is.
I am very concerned that the Governor is working to restrict the citizens of this state while giving one industry the right to pillage our tide lands.
I have taken to hart the rules on our up lands so much so that my children complain they cannot see the water. My neighbors on either side have geo duck feedlots.
They have killed my beach. The question we home owners ask is why we should stick to rules so one industry can kill Puget Sound.
Susan Macomson
From: Susan Mac <susanshaf@comcast.net>
To: <deffoba@co.thurston.wa.us>
Date: 06/21/2012 8:38 PM
Subject: South Sound Sierra

Dear Thurston County commissioners and Staff,
Thank you for all the work you have done on the CAO. Our only Concern is that the SMA and CAO are consistent.
Home owners should not be asked to sacrifice their uplands So one industry can ruin our forage fish habitat. We have many many waterfront families, boaters wind surfers, fishermen, and citizens, who are very concerned about the destruction of our shorelines for aquaculture. If the SMA allows the aquaculture industry to do what ever it wants you will be telling the people of this state who runs Washington ..Industry. We know that you will do the right thing for the citizens of this state.
Susan Macomson
South Sound Sierra Group