Kachemak Bay Submerged Aquatic Vegetation Model

Current Version of Spreadsheet Calculator: April 1, 2026

Introduction:

The Kachemak Bay Submerged Aquatic Vegetation Model was developed in collaboration with the U.S. Army Corps of Engineers Alaska District and National Centers of Coastal Ocean Science, Dr. Ross Whippo. The purpose of the model is to assist in the Feasibility and Preliminary Engineering and Design Phases of the H*omer Navigation Improvemetns Study, AK* . The model has the ability to capture current (baseline) conditions of an area of concern, at different landscape scales and quantify system-level changes under future scenarios. Parameters were developed to capture primarily physical characteristics of submerged aquatic vegetation habitat that play critical roles in the suitability of the environment. Full documentation of model development

User Instructions: Each parameter (variable) is quantified with a Habitat Suitability Index (HSI), which is scaled from 0 to 1. Zero (0) representing poor condition and 1 representing optimal condition of parameter.

1. Click tab labeled HSI calculator
2. Enable content.
3. Enter values in the colorfilled cells in the "HSI Calculator" tab under the baseline columns. Once colored cells are populated the HSI output for variables are automatically populated based on the relationship depicted in the corresponding equation tab. Data cells that are not green should not be filled in as they are not part of the specific Habitat Type module that was chosen in the drop down lists. NOTE: clear all green cells for each new model run to avoid errors of hold over values from different habitat types.
4. The Overall HSI is the geometric mean of the individual HSI variable outputs.
5. Enter a value for Quantity (typically acres, but can be other units) for each time step, located at bottom of
6. Habitat Units (HUs) are automatically calculated by multiplying the Overall HSI by quantity.
7. Area for comments can be expanded to accommodate detail as needed.
8. Use citation for reporting purposes (Fill in current version and date of spreadsheet used): Swannack T., K. N. Campbell, and R. Whippo. 2025. Submerged Aquative Vegetation Model for Kachemak Bay: Development and User’s Guide. DRAFT Technical Report, Environmental Laboratory, U. S. Army Corps of Engineers.

Generating Multiple Calculators for FWOP/FWP Alternatives:

1. Click tab of HSI Calculator
2. Copy all cells in tab
3. Create a new sheet. Rename the new sheet as indicative of alternative.
4. Right click the "Select all Cells" button, select the "Paste" option.
5. Clear all the colored cells before creating new calculations.

Certification: NOT APPROVED - This model has not yet been approved for regional use in accordance with the documented geographic range. The certification of the model is currently scheduled to occur in Preliminary Enginnering and Design Phase of the Homer Navigation Improvements Study, AK. Certification would be conducted by the U. S. Army Corps of Engineers, Ecosystem Restoration National Center of Expertise (Eco-PCX).

Model Documentation:

Development and User’s Guide. DRAFT Technical Report, Environmental Laboratory, U. S. Army Corps of Engineers.

Habitat Suitability Index Calculator

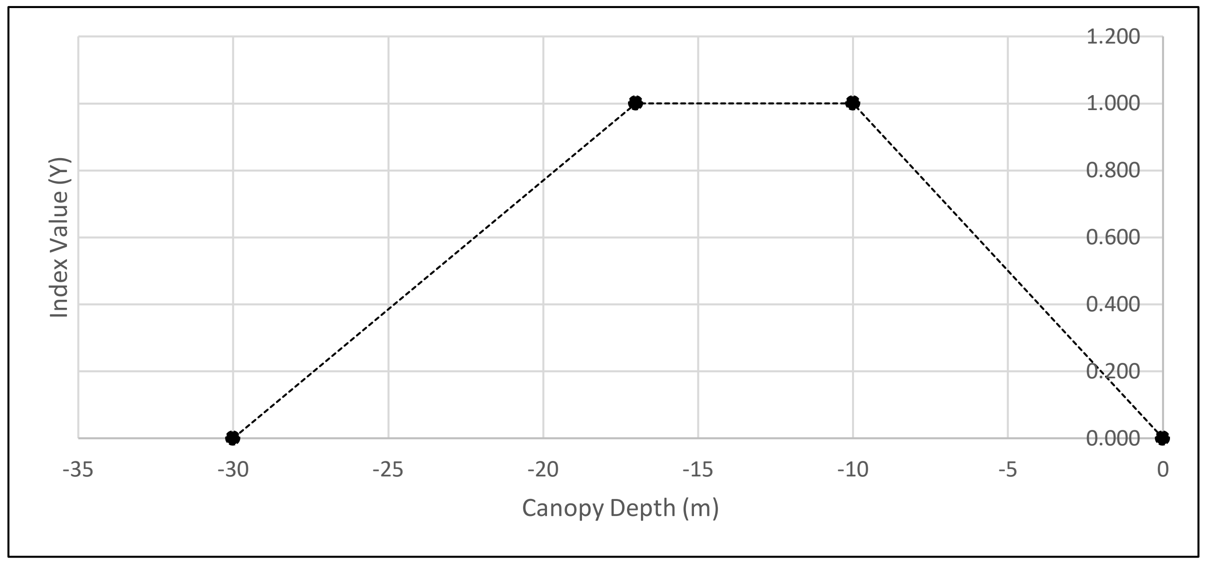
Description	Baseline	0	Year	1	Year	5	Year	10	Year	25	Year	50
	Data	HSI	Data	HSI	Data	HSI	Data	HSI	Data	HSI	Data	HSI
Canopy Depth		0.00		0.00		0.00		0.00		0.00		0.00
Canopy Fetch		0.00		0.00		0.00		0.00		0.00		0.00
Canopy Substrate		#N/A		#N/A		#N/A		#N/A		#N/A		#N/A
Canopy Presence		#N/A		#N/A		#N/A		#N/A		#N/A		#N/A
Seagrass Depth		1.00		1.00		1.00		1.00		1.00		1.00
Seagrass Fetch		1.00		1.00		1.00		1.00		1.00		1.00
Seagrass Substrate		#N/A		#N/A		#N/A		#N/A		#N/A		#N/A
Seagrass Presence		#N/A		#N/A		#N/A		#N/A		#N/A		#N/A
Understory Depth		1.00		1.00		1.00		1.00		1.00		1.00
Understory Fetch		1.00		1.00		1.00		1.00		1.00		1.00
Understory Substrate		#N/A		#N/A		#N/A		#N/A		#N/A		#N/A
Canopy Suitability Score		**0.00**		**0.00**		**0.00**		**0.00**		**0.00**		**0.00**
Seagrass Suitability Score		**0.00**		**0.00**		**0.00**		**0.00**		**0.00**		**0.00**
Understory Suitability Score		**0.00**		**0.00**		**0.00**		**0.00**		**0.00**		**0.00**
Overall Suitability Score		**0.00**		**0.00**		**0.00**		**0.00**		**0.00**		**0.00**
Quantity												
Habitat Unit(s)		**0.00**		**0.00**		**0.00**		**0.00**		**0.00**		**0.00**

ENTER DATA INTO HIGHLIGHTED CELLS

Breakpoint #	Canopy Depth (m)	Index Value (Y)
1	0	0.000
2	-10	1.000
3	-17	1.000
4	-30	0
5		

Values	Intercept	Slope	Equation
0 --10	0.00	-0.1000	Y= 0 + (-0.1 * Canopy Depth (m))
-10 --17	1.00	0.0000	Y= 1 + (0 * Canopy Depth (m))
-17 --30	2.31	0.0769	Y= 2.31 + (0.0769 * Canopy Depth (m))
-30 -	0.00	0.0000	Y= 0 + (0 * Canopy Depth (m))

Documentation
Springer, Y. P., C. G. Hays, M. H. Carr, and M. R. Mackey. 2010. Toward ecosystem-based management of marine macroalgae—The bull kelp, Nereocystis luetkeana. In Oceanography and Marine Biology. 48:1-42.

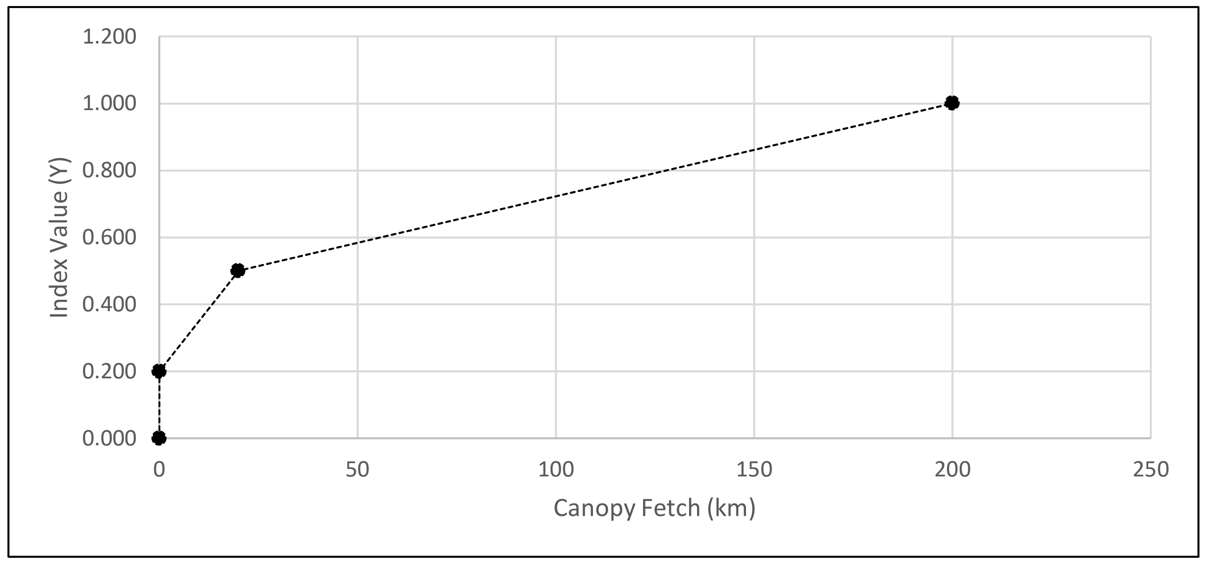


ENTER DATA INTO HIGHLIGHTED CELLS

Breakpoint #	Canopy Fetch (km)	Index Value (Y)
1	0	0.000
2	0.01	0.200
3	20	0.500
4	200	1.000
5		

Values	Intercept	Slope	Equation
0 -0.01	0.00	20.0000	Y= 0 + (20 * Canopy Fetch (km))
0.01 -20	0.20	0.0150	Y= 0.2 + (0.015 * Canopy Fetch (km))
20 -200	0.44	0.0028	Y= 0.44 + (0.0028 * Canopy Fetch (km))
200 -	0.00	0.0050	Y= 0 + (0.005 * Canopy Fetch (km))

Documentation
Smale, D. A., M. T. Burrows, A. J. Evans, N. King, M.D. Sayer, A. L. Yunnie, and P.J. Moore. 2016. Linking environmental variables with regional-scale variability in ecological structure and standing stock of carbon within UK kelp forests. In Marine Ecology Progress Series. 542: 79-95. https://doi.org/10.3354/meps11544.

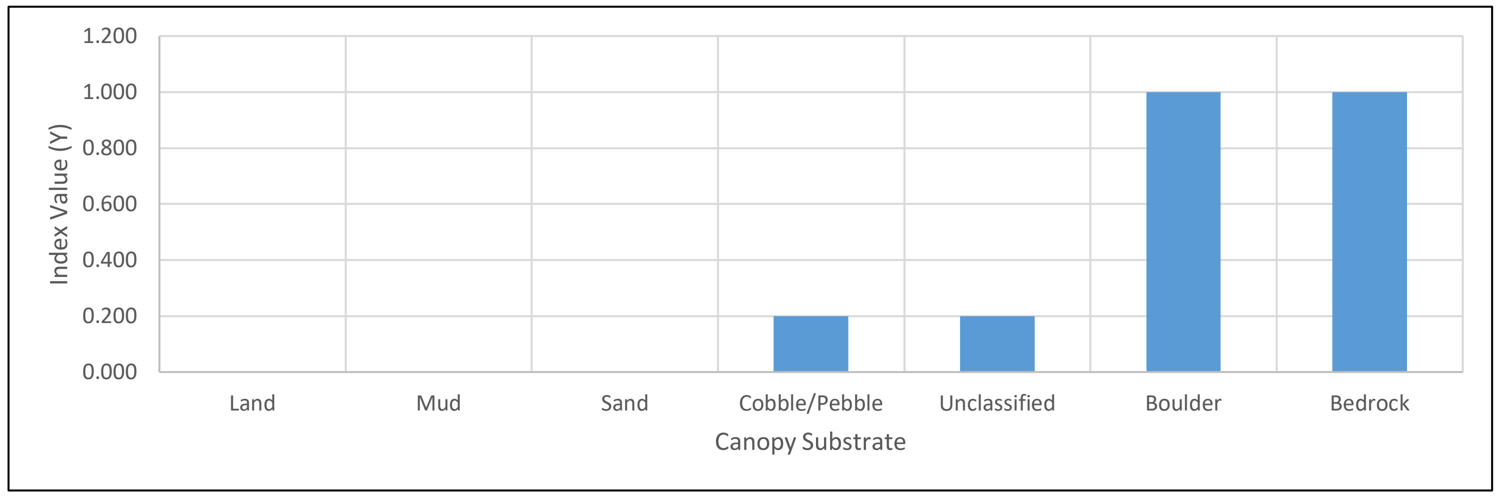


ENTER DATA INTO HIGHLIGHTED CELLS

Breakpoint #	Canopy Substrate	Index Value (Y)
1	Land	0.000
2	Mud	0.000
3	Sand	0.000
4	Cobble/Pebble	0.200
5	Unclassified	0.200
6	Boulder	1.000
7	Bedrock	1.000

Values	Intercept	Slope	Equation
Not Applicable			

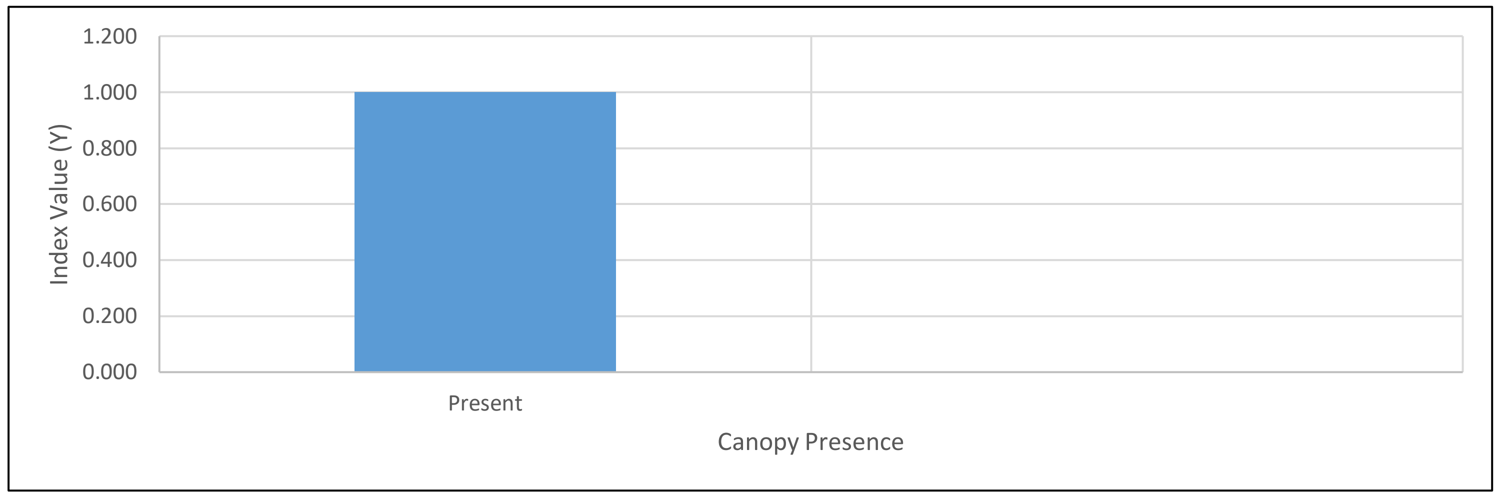
Documentation
Dayton, P. K. 1985. Ecology of Kelp Communities. In Annual Review of Ecology and Systematics 16: 215–45. http://www.jstor.org/stable/2097048.



ENTER DATA INTO HIGHLIGHTED CELLS

Breakpoint #	Canopy Presence	Index Value (Y)
1	Present	1.000
2		

Values	Intercept	Slope	Equation
Not Applicable			



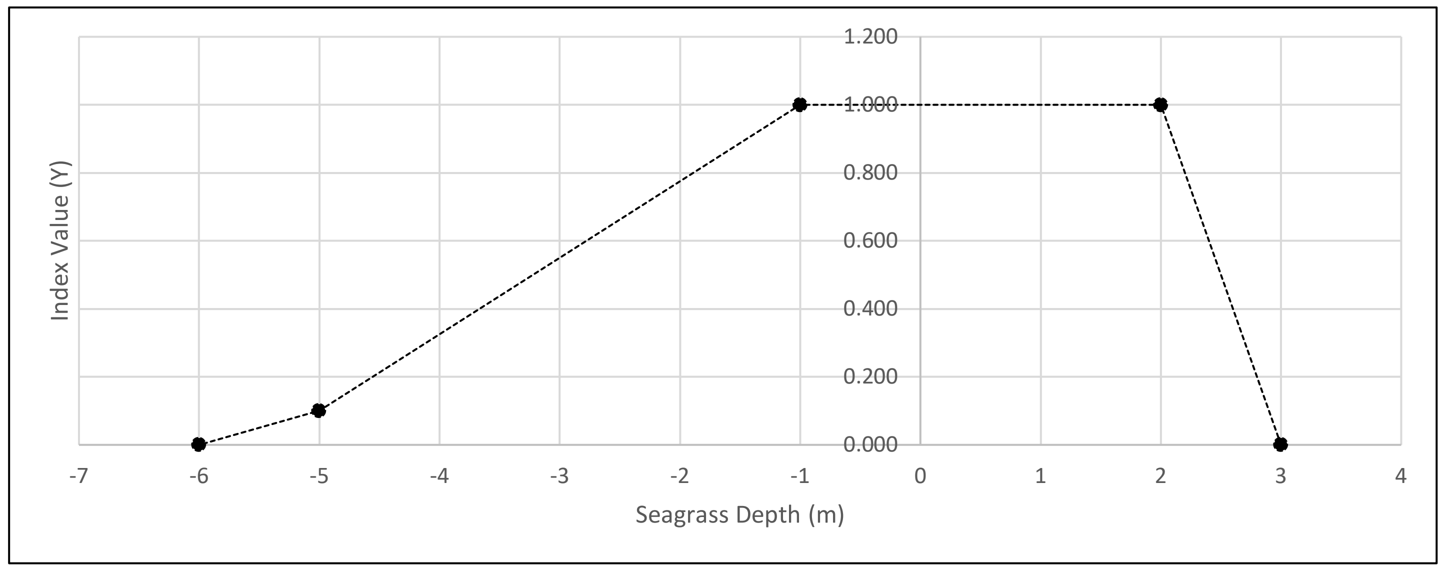
Documentation
Schoch, G. C. 2001. The spatial distribution of Bull Kelp (*Nereocystis leutkeana*) in the Kachemak Bay research reserve. Kachemak Bay Research Reserve. https://kachemakbayreserve.org/wp-content/uploads/2024/01/Schoch-2001-The-spatial-distribution-of-bull-kelp-Nereocystis-leutkeana-in-the-Kachemak-Bay-Research-Reserve.pdf

ENTER DATA INTO HIGHLIGHTED CELLS

Breakpoint #	Seagrass Depth (m)	Index Value (Y)
1	3	0.000
2	2	1.000
3	-1	1.000
4	-5	0.100
5	-6	0.000
6		

Values	Intercept	Slope	Equation
3 -2	3.00	-1.0000	Y= 3 + (-1 * Seagrass Depth (m))
2 --1	1.00	0.0000	Y= 1 + (0 * Seagrass Depth (m))
-1 --5	1.23	0.2250	Y= 1.23 + (0.225 * Seagrass Depth (m))
-5 --6	0.60	0.1000	Y= 0.6 + (0.1 * Seagrass Depth (m))
-6 -	0.00	0.0000	Y= 0 + (0 * Seagrass Depth (m))

Documentation
Thom, R. M., S. L. Southard, A. B. Borde, and P. Stoltz. 2008. Light requirements for growth and survival of eelgrass (*Zostera marina L* .) in Pacific Northwest (USA) estuaries. In Estuaries and Coasts. 31:969-80. https://doi.org/10.1007/S12237-008-9082-3.

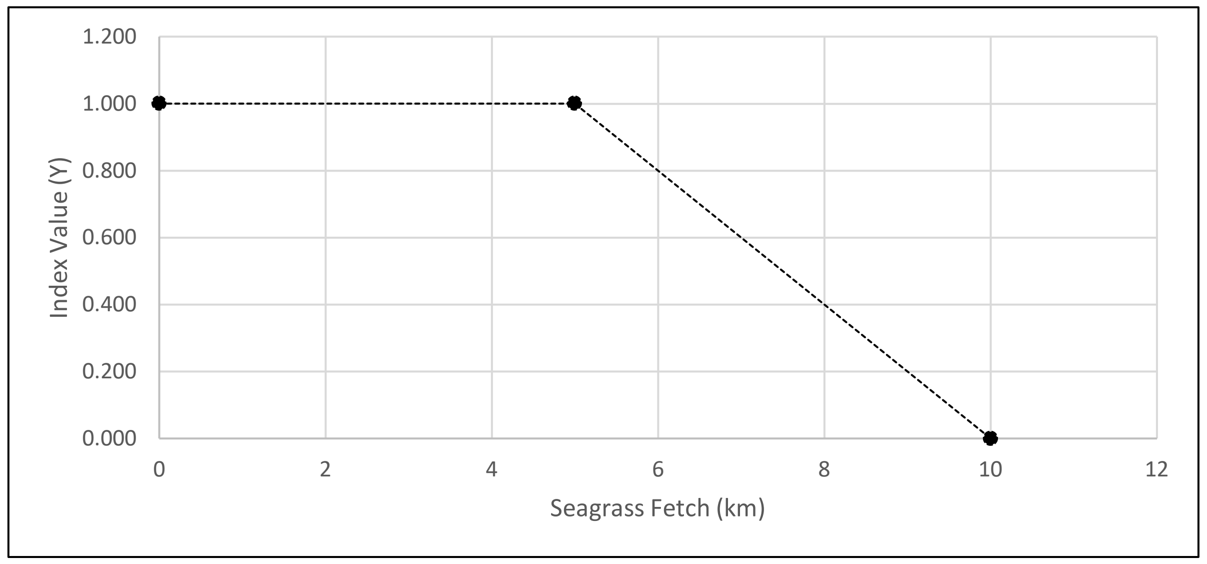


ENTER DATA INTO HIGHLIGHTED CELLS

Breakpoint #	Seagrass Fetch (km)	Index Value (Y)
1	0	1.000
2	5	1.000
3	10	0.000
4		

Values	Intercept	Slope	Equation
0 -5	1.00	0.0000	Y= 1 + (0 * Seagrass Fetch (km))
5 -10	2.00	-0.2000	Y= 2 + (-0.2 * Seagrass Fetch (km))
10 -	0.00	0.0000	Y= 0 + (0 * Seagrass Fetch (km))

Documentation
Oreska, M. P., K. J. McGlathery, P. L. Wiberg, R. J. Orth, and D. J. Wilcox. 2021. Defining the *Zostera marina* (eelgrass) niche from long-term success of restored and naturally colonized meadows: Implications for seagrass restoration. In Estuaries and Coasts. 44 (2): 396-411.

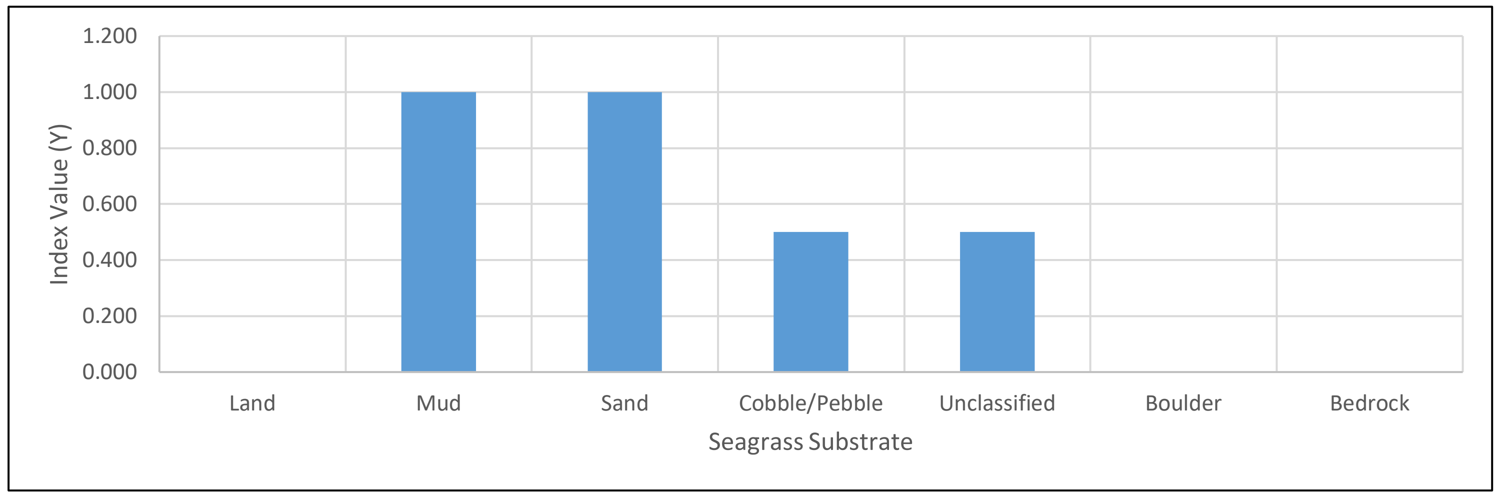


ENTER DATA INTO HIGHLIGHTED CELLS

Breakpoint #	Seagrass Substrate	Index Value (Y)
1	Land	0.000
2	Mud	1.000
3	Sand	1.000
4	Cobble/Pebble	0.500
5	Unclassified	0.500
6	Boulder	0.000
7	Bedrock	0.000

Values	Intercept	Slope	Equation
Not Applicable			

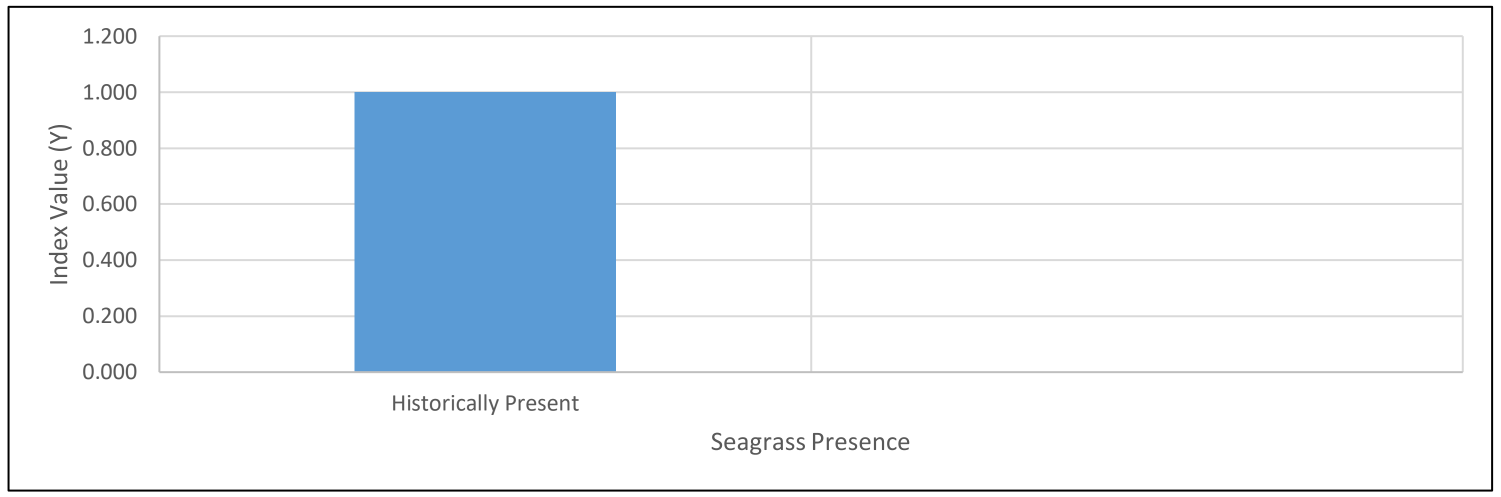
Documentation
Larkum. A. W., R. J. Orth, and C. M. Duarte. 2006. Seagrasses: Biology, Ecology and Conservation. In Phycologia. 45 (5): 5. https://doi.org/10.1007/978-1-4020-2983-7.



ENTER DATA INTO HIGHLIGHTED CELLS

Breakpoint #	Seagrass Presence	Index Value (Y)
1	Historically Present	1.000
2		

Values	Intercept	Slope	Equation
Not Applicable			



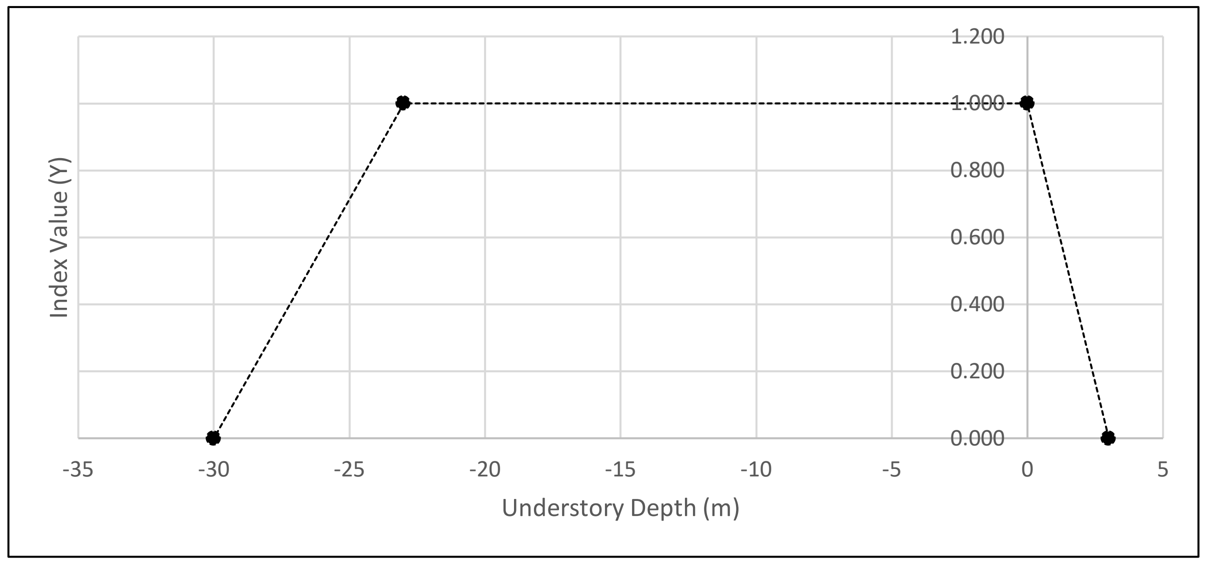
Documentation
Field, D., A. Malhotra, K. Holderied, and C. Taylor. 2020. NCCOS mapping: seafloor mapping products for Kachemak Bay, Cook Inlet, AK, from 2005-07-06 to 2017-07-19 (NCEI Accession 0209109). National Oceanic and Atmospheric Administration National Centers for Environmental Information. Dataset. https://doi.org/10.25921/2nha-4780. Field, D., A. Malhotra, and K. Buja. 2005. Seagrass. In Benthic Mapping Kachemak Bay (Map Server). National Centers for Coastal Ocean Science. https://gis.ngdc.noaa.gov/arcgis/rest/services/nccos/BenthicMapping_KachemakBay/MapServer. Additional seagrass data collected by National Centers for Coastal Ocean Science (Dr. Ross Whippo) is currently unpublished.

ENTER DATA INTO HIGHLIGHTED CELLS

Breakpoint #	Understory Depth (m)	Index Value (Y)
1	3	0.000
2	0	1.000
3	-23	1.000
4	-30	0
5		

Values	Intercept	Slope	Equation
3 -0	1.00	-0.3333	Y= 1 + (-0.3333 * Understory Depth (m))
0 --23	1.00	0.0000	Y= 1 + (0 * Understory Depth (m))
-23 --30	4.29	0.1429	Y= 4.29 + (0.1429 * Understory Depth (m))
-30 -	0.00	0.0000	Y= 0 + (0 * Understory Depth (m))

Documentation
Bekkby, T., C. Smit, H. Gundersen, E. Rinde, H. Steen, L. Tveiten, J. K. Gitmark, S. Fredriksen, J. Albretsen, and H. Christie. 2019. The Abundance of Kelp Is Modified by the Combined Impact of Depth, Waves and Currents. In Frontiers in Marine Science 6. https://doi.org/10.3389/fmars.2019.00475.

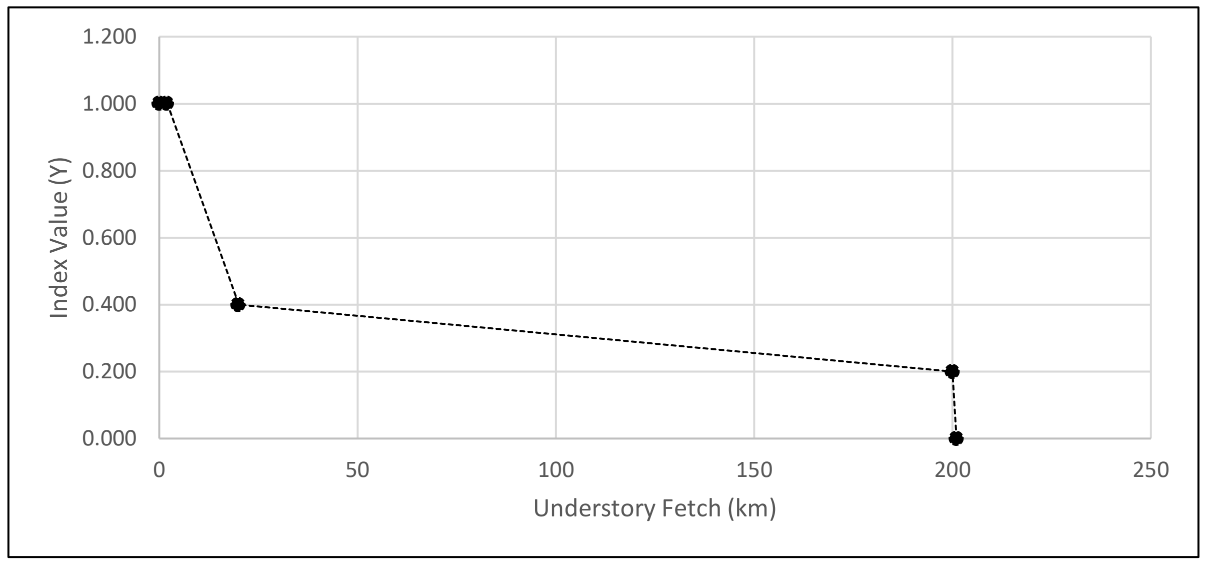


ENTER DATA INTO HIGHLIGHTED CELLS

Breakpoint #	Understory Fetch (km)	Index Value (Y)
1	0	1.000
2	2	1.000
3	20	0.400
4	200	0.2
5	201	0
6		

Values	Intercept	Slope	Equation
0 -2	1.00	0.0000	Y= 1 + (0 * Understory Fetch (km))
2 -20	1.07	-0.0333	Y= 1.07 + (-0.0333 * Understory Fetch (km))
20 -200	0.42	-0.0011	Y= 0.42 + (-0.0011 * Understory Fetch (km))
200 -201	40.20	-0.2000	Y= 40.2 + (-0.2 * Understory Fetch (km))
201 -	0.00	0.0000	Y= 0 + (0 * Understory Fetch (km))

Documentation
Bekkby, T., and F. E. Moy. 2011. Developing spatial models of sugar kelp (*Saccharina latissima*) potential distribution under natural conditions and areas of its disappearance in Skagerrak. In Estuarine, Coastal and Shelf Science 95 (4): 477-83. https://doi.org/10.1016/j.ecss.2011.10.029.



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Breakpoint #	Understory Substrate	Index Value (Y)
1	Land	0.000
2	Mud	0.000
3	Sand	0.000
4	Cobble/Pebble	0.400
5	Unclassified	0.200
6	Boulder	1.000
7	Bedrock	1.000

Values	Intercept	Slope	Equation
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Documentation
Dayton, P. K. 1985. Ecology of Kelp Communities. In Annual Review of Ecology and Systematics 16: 215–45. http://www.jstor.org/stable/2097048.