Understanding Climate Change Impacts to Natural Resources through the Use of Vulnerability Assessments

NRCS State Technical Committee Meeting, December 7, 2011

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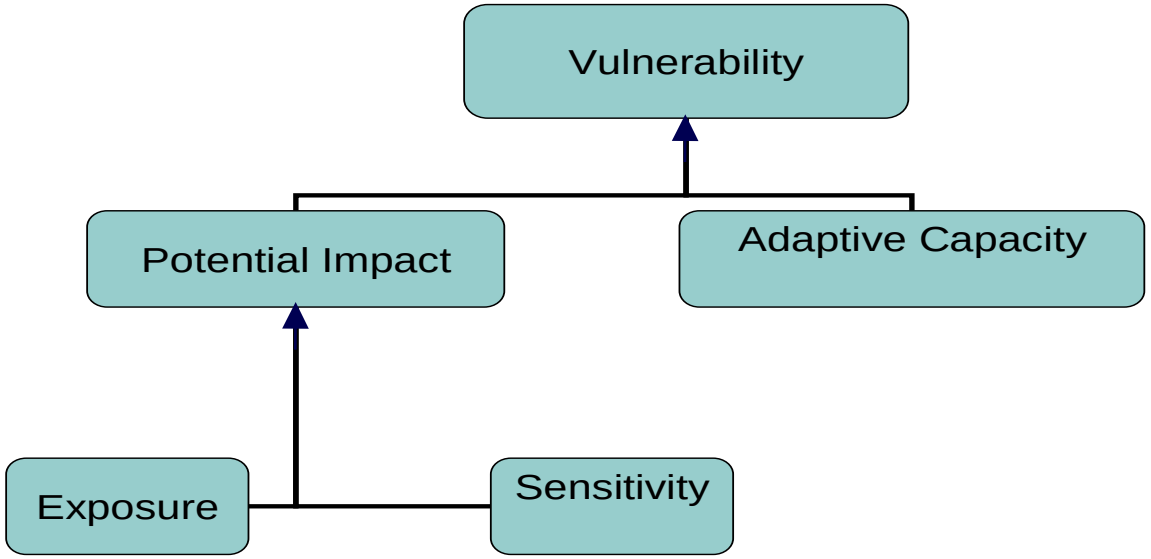
Vulnerability Assessments

Vulnerability and Its Components



Two Main Points

- Fish, wildlife and their habitats will be **lost** while others will **gain** under climate change conditions
- Fish and Wildlife Agencies must reach across sectors to ensure that adaptation strategies developed by others include an understanding of how they may **positively** or **negatively impact** the fish and wildlife resources under their jurisdiction

Vulnerability Assessment Goal

To ensure that the wildlife conservation strategies detailed in the State Wildlife Action Plan (SWAP) are adapted for climate change impacts

Vulnerability Assessments

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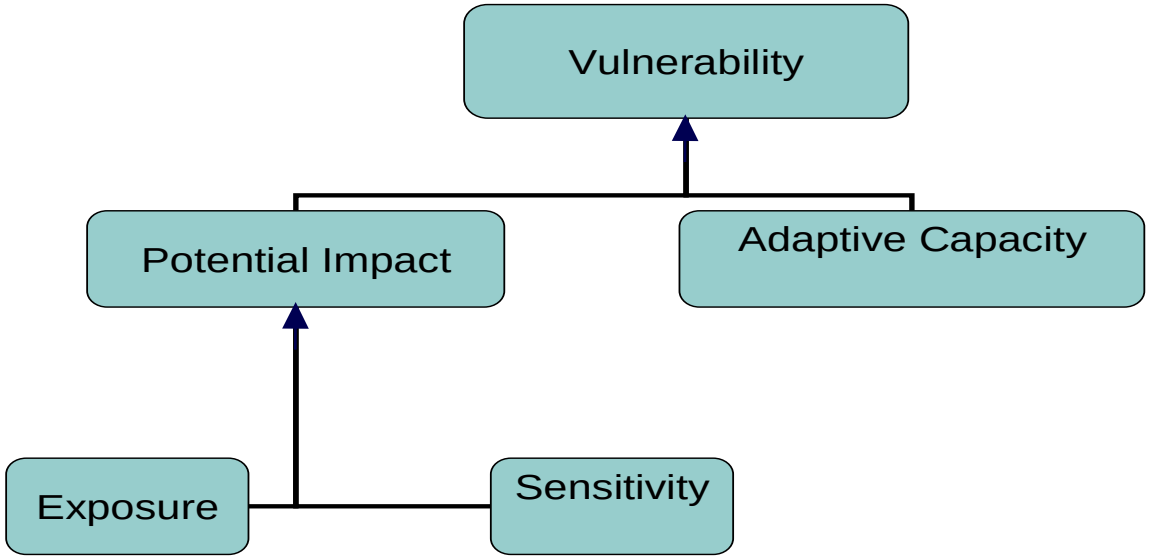


Exposure

Table 3. Absolute values for the reference period 1961-1990 and projected future changes in key climate indicators for the period 2035-2064 and 2070-2099. Changes significantly different relative to the 1961-1990 annual distribution at the 99.9% confidence level or higher as determined by a student t-test are highlighted in **bold**, and changes significantly different under A1FI and/or A2 relative to B1 at the 99.9% confidence level are underlined.

		1961-1990	2035-2064			2070-2099		
	UNITS	20C3M	B1	A2	A1FI	B1	A2	A1FI
Temperature								
Annual	°C	7.8	**+2.1**	**+2.5**	**+2.9**	**+2.9**	**+4.5**	**+5.3**
Winter (DJF)	°C	-4.8	+1.1	+1.7	**+3.1**	**+1.7**	**+3.7**	**+5.4**
Summer (JJA)	°C	20.0	**+1.6**	**+2.2**	**+3.1**	**+2.4**	**+4.3**	**+5.9**
Precipitation								
Annual	cm (%)	102.9	+5%	+6%	**+8%**	+7%	**+9%**	**+14%**
Winter (DJF)	cm (%)	20.95	+6%	+8%	**+16%**	+12%	+14%	**+30%**
Summer (JJA)	cm (%)	28.03	-1%	-1%	+3%	-1%	-2%	0%
Sea Surface Temperatures[1]								
Gulf of Maine	°C	11.6[1]	+1.3[1]	+1.5[2]	–	**+1.9**[1]	**+3.3**[2]	–
Gulf Stream	°C	23.4[1]	+0.9[1]	**+1.3**[2]	–	**+1.2**[1]	**+2.3**[2]	–
Terrestrial Hydrology								
Evaporation	mm/day	1.80	+0.10	–	+0.16	**+0.16**	–	**+0.20**
Runoff	mm/day	1.14	+0.12	–	+0.09	**+0.21**	–	+0.18
Soil Moisture	% sat	55.0	+0.4	–	+0.02	+1.0	–	-0.07
Streamflow								
Timing of spring peak flow centroid	days	84.5	-5	–	-8	**-11**	–	**-13**
Low flow days (Q<0.0367 m3/s/km2)	days	65.5	-14	–	-1.5	-26	–	+22
7-Day low flow amount	%	100%	-4	–	-1	-4	–	**-11**
Drought Frequency								
Short	no. of droughts per 30 years	12.61	+5.12	–	+7.19	+3.06	–	**+9.99**
Med	no. of droughts per 30 years	0.57	+0.03	–	+0.51	+0.39	–	**+2.21**
Long	no. of droughts per 30 years	0.03	+0.03	–	+0.11	+0.04	–	**+0.39**
Snow								
Total SWE	mm	11.0	-4.4	–	**-5.5**	**-5.9**	–	**-9.3**
Number of snow days	days/mnth	5.2	**-1.7**	–	**-2.2**	**-2.4**	–	**-3.8**
Growing Season[2]								
First frost (autumn)	day	295	+1	**+16**	–	**+6**	**+20**	–
Last frost (spring)	day	111	-8	**-14**	–	**-16**	**-23**	–
Length of growing season	days	184	**+12**	**+27**	–	**+29**	**+43**	–
Spring Indices[2]								
First leaf	day	98.8	**-3.0**	**-5.2**	**-3.9**	**-6.7**	**-15**	**-15**
First bloom	day	128.8	**-3.7**	**-6.0**	**-5.6**	**-6.3**	**-15**	**-16**

[1] Based on SST output ("tos") from HadCM3, MIROC, CGCM CCSM, and PCM only

[2] Time periods restricted by output availability to 2047-2065 and 2082-2099.

Sensitivity and Adaptive Capacity Variables

1. Current rate of loss
2. Elevation
3. Latitude
4. Vulnerability to increasing temperature
5. Vulnerability to increased attack by biological stressors (grazers and browsers, pests, invasives, pathogens)
6. Habitat intrinsic dispersive rate
7. Vulnerability to increased frequency or intensity of extreme events (fire, drought, windstorms, floods)
8. Vulnerability to phenologic change
9. Vulnerability to human maladaptive responses
10. Vulnerability due to obstacles to range shifts
11. Likely future impacts of non-climate stressors

Habitat Vulnerability Scoring System

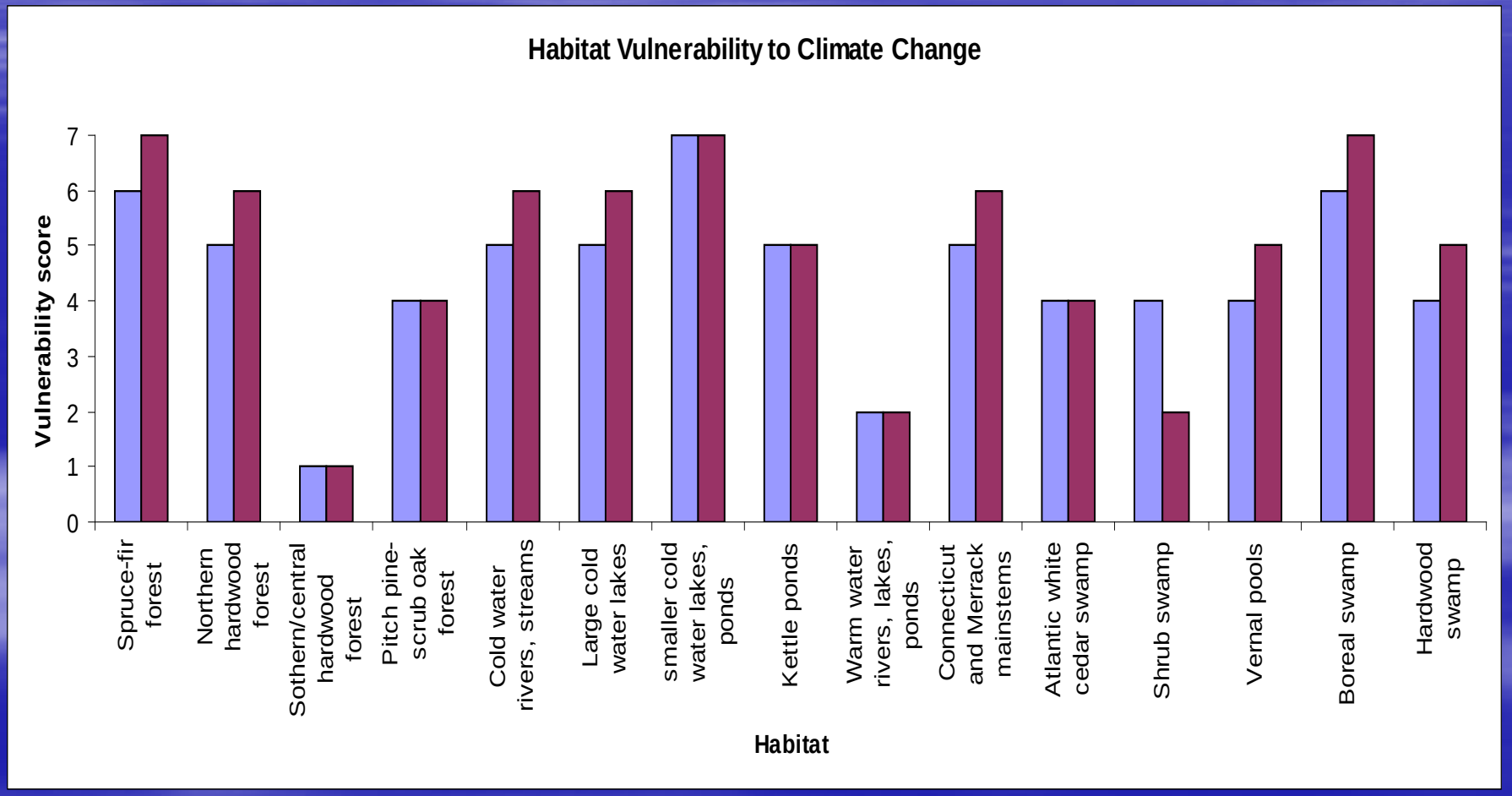
7	At Risk of being eliminated
6	Greater than 50% loss expected
5	Moderately reduced (< than 50%)
4	May not change appreciably
3	Newly established within state from outside
2	May expand moderately (< than 50%)
1	May expand greatly (> than 50%)

CONFIDENCE EVALUATION

- High confidence >70% confidence
- Medium confidence between 30% and 70% confidence
- Low confidence <30% confidence

- This system is based on the 5-category scale developed by Moss and Schneider for the Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report.

Results:
Within State Habitat Vulnerability Rankings



PITCH PINE-SCRUB OAK VULNERABILITY EVALUATION

NTWHCS category: Northeastern Interior Pine Barrens/North Atlantic Coastal Plain Pitch Pine barrens

State ranking S2

Vulnerability score **4 (both emissions scenarios)**

Confidence evaluation **Low** [sb1]

Rationale

Its range extending south to New Jersey and Maryland, this community type reaches its northern limit on sandy, nutrient-poor, drought-prone soils in southern Maine, on Cape Cod, in the southern part of the Massachusetts coastal plain, and in the Connecticut River Valley (see Massachusetts Natural Heritage and Endangered Species Program map below). It is therefore a southern community type that extends into southern and central New England. Its canopy is dominated by Pitch Pine, with an understory of Scrub Oak, Huckleberry, and Lowbush Blueberry. The system is fire-maintained and will revert to White Pine or oak-dominated forest in the absence of fire (NHESP, 2007).

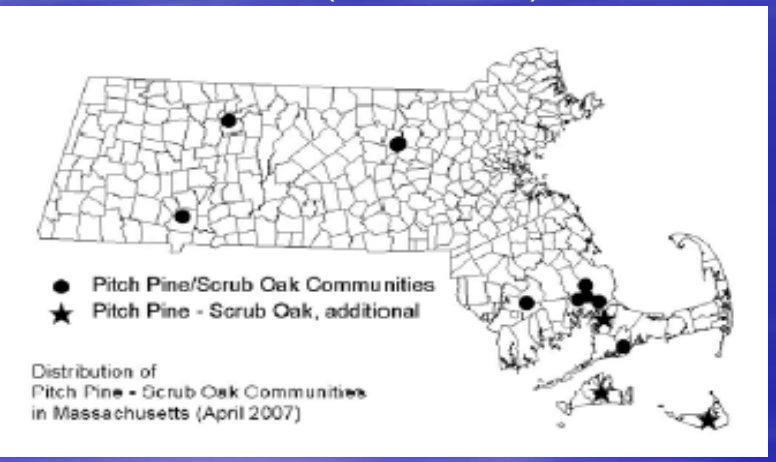


Figure 1. Distribution of Pitch pine-scrub oak communities in Massachusetts.

Pitch pine-scrub oak occurs in significantly warmer climates to the south in New Jersey and Maryland. If the only determinant of its distribution were climate, it would be likely that its distribution in Massachusetts would extend under a warming climate. However, non-climatic factors, mainly the distribution of sandy, nutrient-poor soils; fire frequency; and development, are also important factors. These are likely to be the main limiting factors in any future spread of pitch pine barrens, not climate change. Based on this, a vulnerab score of 4 (extent of habitat may not change appreciably under climate change) has been assigned for both scenarios. The confidence score that we assign for this community type is Low. This is because its future distribution is dependent on uncertain human settlement patterns and responses to climate change. Urban development is already a major fragmenting factor affecting this forest type and it is unlikely that this pressure will ease over the next few decades. Also, as the summers warm and droughts become more frequent and prolonged, fire outbreaks may become more frequent and/or intense. How humans respond to this is a major uncertainty. If the societal response is increased fire suppression (to protect property and lives), it could result in further loss and fragmentation of this habitat type

Products

- **CLIMATE CHANGE AND MASSACHUSETTS FISH AND WILDLIFE:** INTRODUCTION AND BACKGROUND
- **CLIMATE CHANGE AND MASSACHUSETTS FISH AND WILDLIFE:** HABITAT AND SPECIES VULNERABILITY
- **CLIMATE CHANGE AND MASSACHUSETTS FISH AND WILDLIFE:** HABITAT MANAGEMENT

Using the Vulnerability Assessment Results

- **Management**: Increase size of replacement culverts on Wildlife Management Areas
- **Acquisition**: Add results of the Vulnerability Assessment under threats in existing land acquisition process
- **Regulation**: Climate change impacts may require changes to existing regulations. Examples include: intermittent versus perennial stream designation, allowed wetlands protection measures
- **Monitoring**: Breeding Bird Atlas

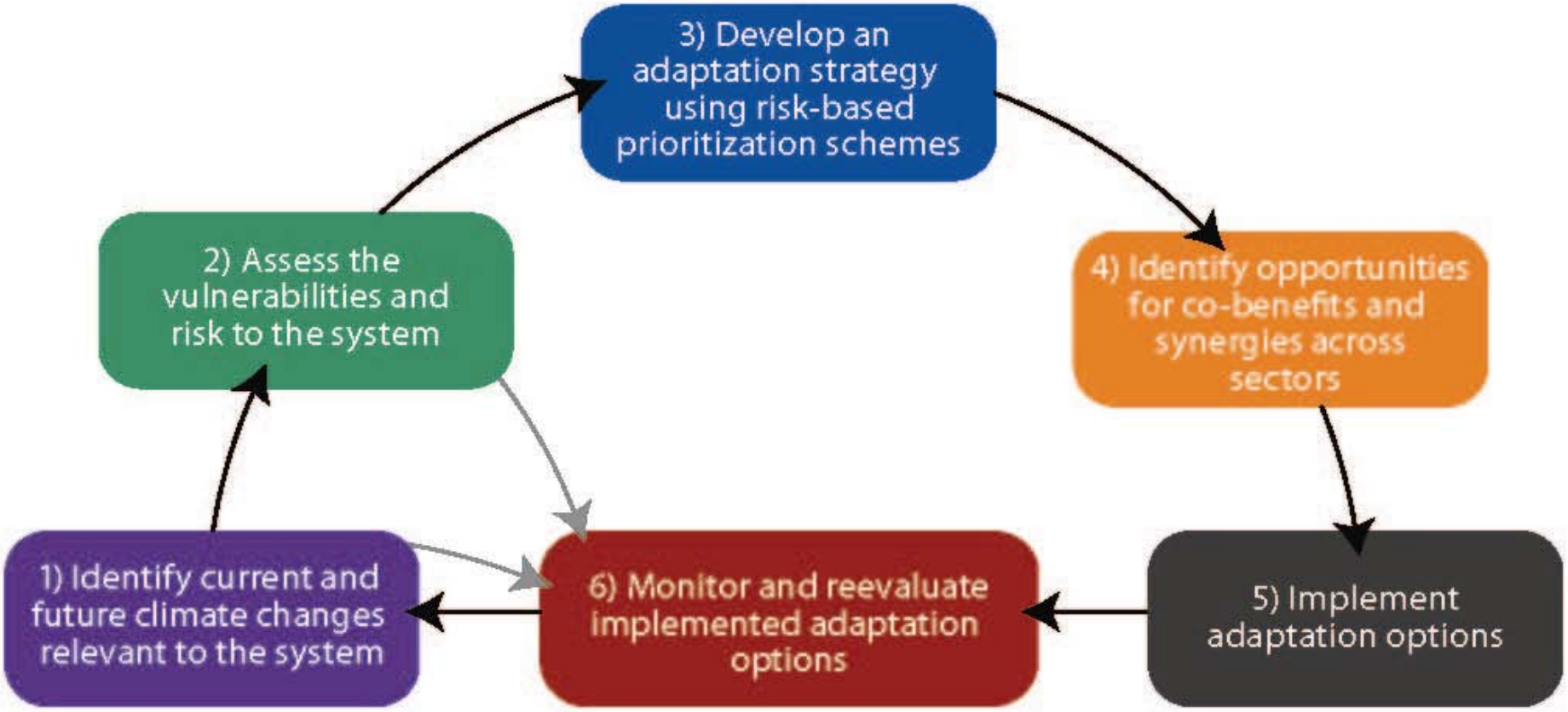


FIGURE S.1 The planning process is envisioned to incorporate the following steps: 1) Identify current and future climate changes relevant to the system; 2) Assess the vulnerabilities and risk to the system; 3) Develop an adaptation strategy using risk-based prioritization schemes; 4) Identify opportunities for co-benefits and synergies across sectors 5) Implement adaptation options 6) Monitor and reevaluate implemented adaptation options.

Include Natural Resource Values in Adaptation Planning

For their own sake (Recreation, food, environmental services, etc)

So that other sector adaptation strategies do not result in maladaptive consequences for fish and wildlife resources

Co-benefits are in the eye of the beholder

MASSACHUSETTS
CLIMATE CHANGE ADAPTATION REPORT
September 2011

Submitted by the
Secretary of Energy and Environmental Affairs
And the
Adaptation Advisory Committee
Secretary of Energy and Environmental Affairs

www.mass.gov/environment/cca

Context

- Northeast Association of Fish and Wildlife Agencies Regional Wildlife Habitat Climate Change Vulnerability Assessment
- Developing Tools and Training to take the Statewide Assessment and make it useful to local planners

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