Urban Foresters' Response to Climate Change

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- **Cecilia Shoopmann**, B.S. Environmental Science 2020 (project research assistant, 2017-present)
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Other collaborators

- **Dr. Tenley Conway**, University of Toronto Mississauga
- **Dr. Adrina Bardekjian**, University of British Columbia

Main research question:

How are urban foresters changing their decision-making and management activities in response to the major symptoms of climate change?

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How are urban foresters changing their decision-making and management activities in response to the major symptoms of climate change?

Climate change from a social science perspective.
Human adaptation

Outline

1. Urban forester profession – what do “urban foresters” do?
2. Impact of climate change on urban forests
3. My research: How are urban foresters responding to the symptoms of climate change?
   - Methods
   - Results in Chicago-area & Canada
4. Next steps

1. What do “urban foresters” do?

Urban forestry as a profession: Canadian beginnings

- Jorgensen (1970):

  - "Urban forestry is a specialized branch of forestry and has as its objectives the cultivation and management of trees for their present and potential contribution to the physiological, sociological and economic well-being of urban society. These contributions include the overall ameliorating effect of trees on their environment, as well as their recreational and general amenity value."

As cited in: Konijnendijk, C.C., et al., 2006. *Urban For Urban Green,* 4: 93–103. doi:10.1016/j.ufug.2005.11.003

Urban forestry profession in the U.S.

- Society of American Foresters (originally in 1970):
  - "The art, science, and technology of managing trees and forest resources in and around urban community ecosystems for the physiological, sociological, economic, and aesthetic benefits tree provide society"

- Miller (1997) – one of the first urban forestry textbooks
  - "…the art of reproducing and managing forests continuously to obtain sustained yields of forest benefits in urban regions through the application of ecological principles. Traditional silviculture places emphasis on wood production, while urban silviculture has as primary functions recreation and environmental protection, but does not preclude wood fiber production. The transition in management concepts from arboriculture to silviculture becomes somewhat arbitrary in urban forest management. Care of individual trees is arboriculture and management of tree communities is silviculture, but in urban forestry a forest community may be manipulated as a whole, while a tree in that community receives individual attention."

As cited in: Konijnendijk, C.C., et al., 2006. *Urban For Urban Green,* 4: 93–103. doi:10.1016/j.ufug.2005.11.003

Ultimately, urban forestry means managing the entire population of trees within a city

- Population of trees = all trees within the city
- Different urban foresters might manage different sub-populations of trees…
  - Public trees
    - Street trees
    - Park trees
  - Private trees
    - Commercial business parks
    - Residential communities
    - Private yards of homeowners

Typical urban forestry activities

- Planting trees
- Removing trees
- Maintaining trees – commonly:
  - Mulching
  - Pruning
  - Watering
  - Chronic pest management
- Inventory, monitoring, & risk management (safety)
- *Special activities:* Acute pest outbreaks, storm clean-up, tree protection during construction, managing old or special trees of great significance, wildfire management…and more.
- Also…PLANNING!!!

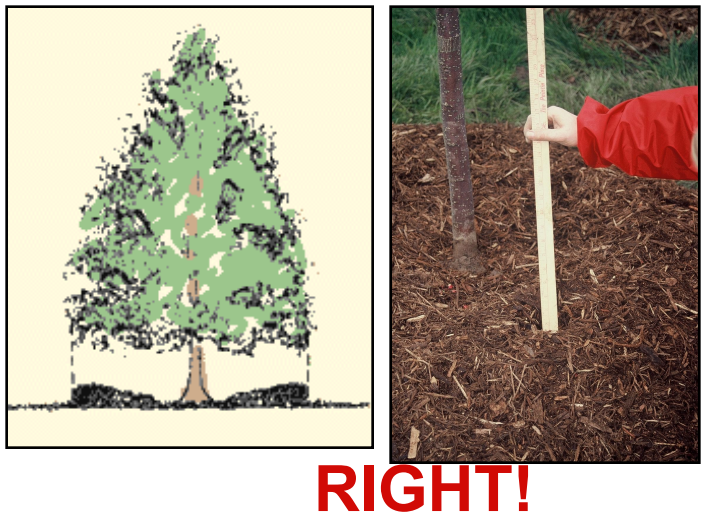
Mulch

- Survival
- Moisture loss
- Soil Structure
- Nutrients
- Water runoff /soil erosion
- Mowing
- Weeds
- Soil temperature

Illustrations (or photos) by Edward F. Gilman, Professor, Environmental Horticulture Department, IFAS, University of Florida.

How to Mulch

- 4-6 cm thick
- Extend 1-2 m wide or to the drip line of the tree
- Pull 6+ cm away from tree trunk



Mulching

Correct

Create a doughnut-shaped mulch ring that doesn't touch the trunk of the tree

Incorrect

mulch touching trunk of tree

Pruning

- no single leader; three main branches
- one was chosen to become main leader

Sapling planted April 2000; photo taken October 2001.

Pruning

- no single leader; three main branches
- one was chosen to become main leader

Sapling planted April 2000; photo taken October 2001.

Same tree in 2005

Watering New Trees

- Thoroughly at planting
- Supplement rainfall until established
- Soil should dry in between watering

Watering

- Spring to first freeze
- Moisture level of soil
  - Dig into soil and feel 10-15 cm deep
  - Powdery or crumbles – water
- Water 10-15 litres per 2.5 cm diameter of tree per week
- Devise a schedule for your situation

Watering

- Overwatering
  - Forces oxygen from the soil, which starves the roots for oxygen
    - Causes yellowing leaves low and on inside of the tree and progresses outward
  - Will cause the roots to start rotting
- Underwatering
  - Frequent light watering
    - Causes shallow roots which become susceptible to winter injury and summer stress

Maintenance strategy

- Type
- Intensity
- Frequency
- Duration
- Extent

Vogt, J., et al. 2015, *Arboriculture & Urban Forestry,* 41(6):293-323.

Maintenance strategy

- Type – what kind of maintenance. Ex.:
  - *Pruning, staking, mulching, watering…*
- Intensity
- Frequency
- Duration
- Extent

Vogt, J., et al. 2015, *Arboriculture & Urban Forestry,* 41(6):293-323.

Maintenance strategy

- Type
- Intensity – how much maintenance is performed. Ex.:
  - *Training pruning, structural pruning*
  - *10-15 litres of water*
- Frequency
- Duration
- Extent

Vogt, J., et al. 2015, *Arboriculture & Urban Forestry,* 41(6):293-323.

Maintenance strategy

- Type
- Intensity
- Frequency – how often the activity is performed. Ex.:
  - *Once per year*
  - *Once every week it doesn't rain >2-3 cm*
- Duration
- Extent

Vogt, J., et al. 2015, *Arboriculture & Urban Forestry,* 41(6):293-323.

Maintenance strategy

- Type
- Intensity
- Frequency
- Duration – for how long is the activity done? Ex.:
  - *For the 5 five years after transplanting*
  - *For the tree's entire life*
- Extent

Vogt, J., et al. 2015, *Arboriculture & Urban Forestry,* 41(6):293-323.

Maintenance strategy

- Type
- Intensity
- Frequency
- Duration
- Extent – which trees or what part of a tree. Ex.:
  - *Lower branches hanging below 2.5 m above sidewalk*
  - *All trees in right-of-way on the 800 block of N. College*

Vogt, J., et al. 2015, *Arboriculture & Urban Forestry,* 41(6):293-323.

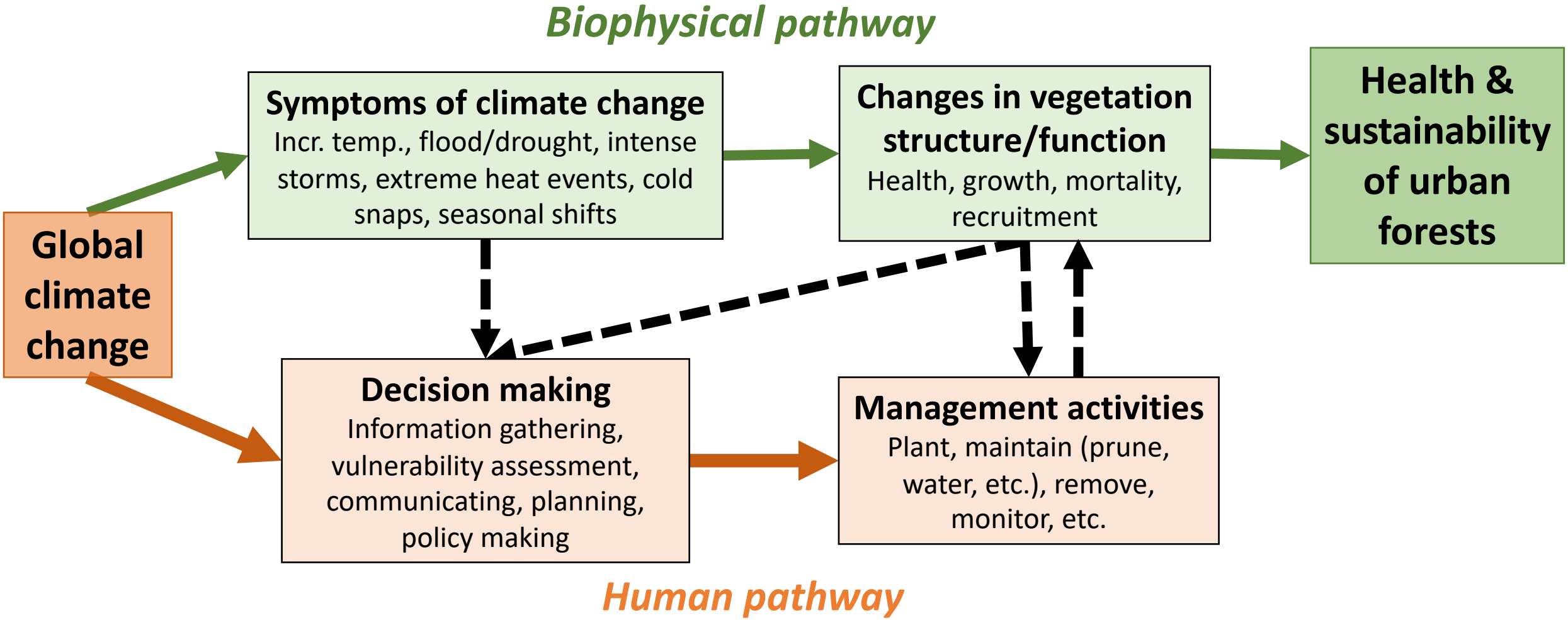
2. Impact of climate change on urban forests

Change in forest habitat suitability

- Of 134 tree species found in the eastern United States…
  - 66 species would gain range
  - 54 species would lose at least 10% of their suitable habitat

Iverson, L., et al., 2008. *Forest Ecology and Management* 254 (2008) 390–406

Climate change impacts urban forests via two pathways: biophysical + human



Vogt, Espeland, & Shoopmann, *manuscript in preparation*

Climate change might change the maintenance strategy urban trees require…

- Drought = more water needed for not only newly planted trees but mature trees
- Floods = better soil management to avoid water-logging of roots
- Storms = more costly and intensive clean-up of fallen branches and failed trees after more intense and more frequent storms
- Extreme temperatures = managing associated pest outbreaks, e.g., mistletoe in Melbourne
- Seasonal shifts = changes when trees can/should be planted for greatest survival
- All of the above – impact species selection

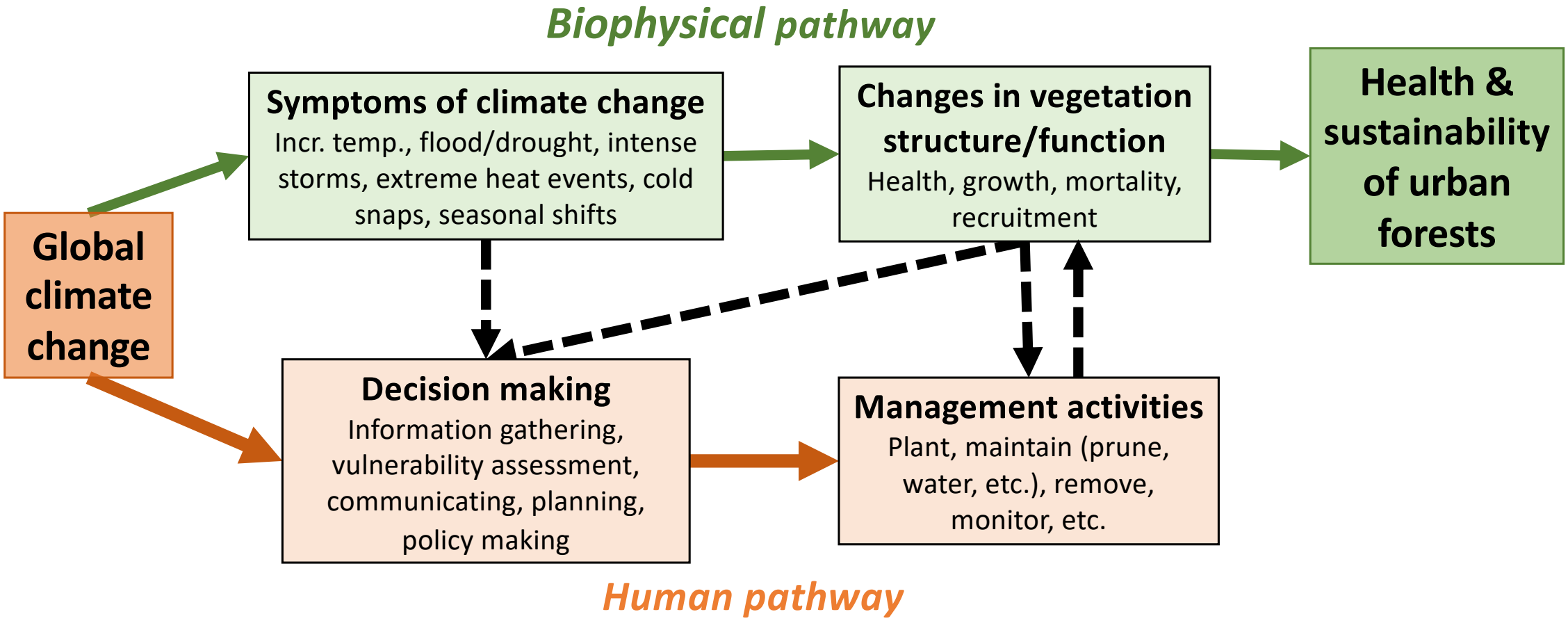
3. How are urban foresters responding to climate change?

(And the symptoms of climate change)

Project origins

- Informal conversations with Chicago-area urban foresters about climate change – what they were seeing, what they were doing about it, what they wish they could do about it

This is the conceptual framework we used



Vogt, Espeland, & Shoopmann, *manuscript in preparation*

How best to answer our research question?

- Since we're interested in what people are doing (what actions they are taking), we can use…
- "Self-report measures"
  - People tell you what they are doing or what they think in a questionnaire
- But...there is a slight problem!
  - People may not know they are responding to climate change!
  - May not connect symptoms with climate change

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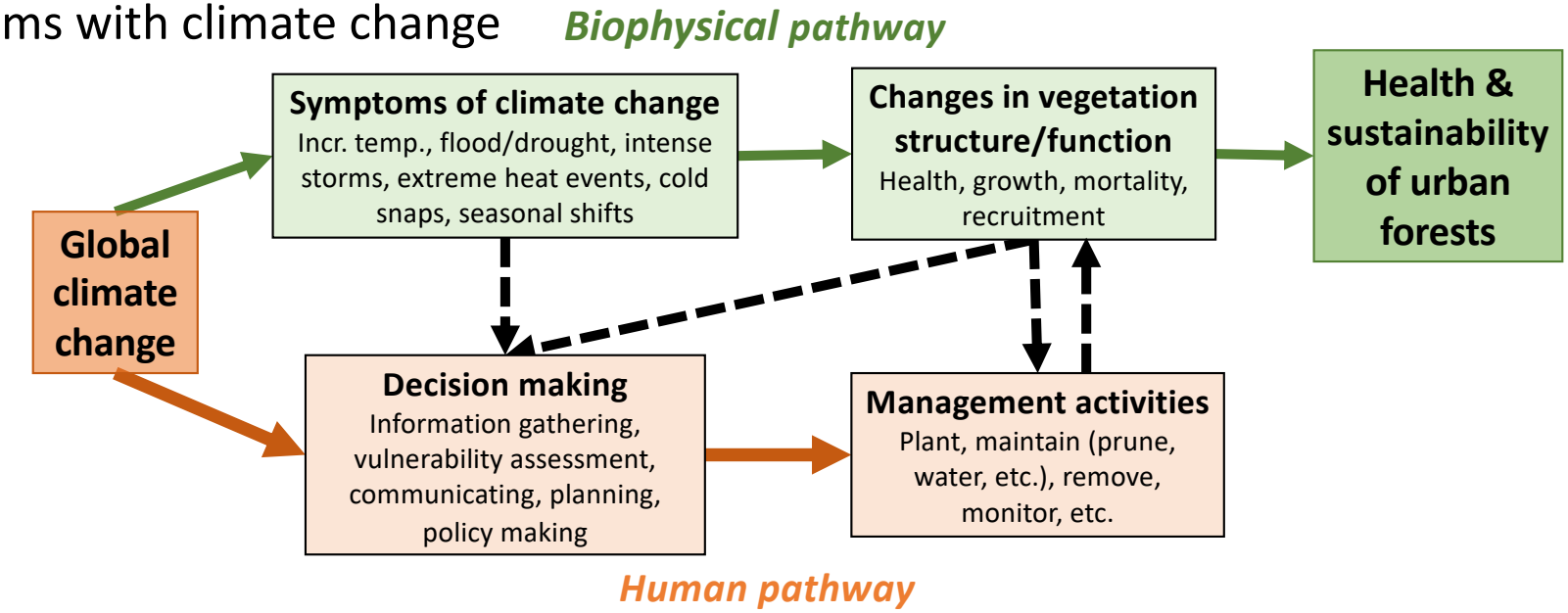

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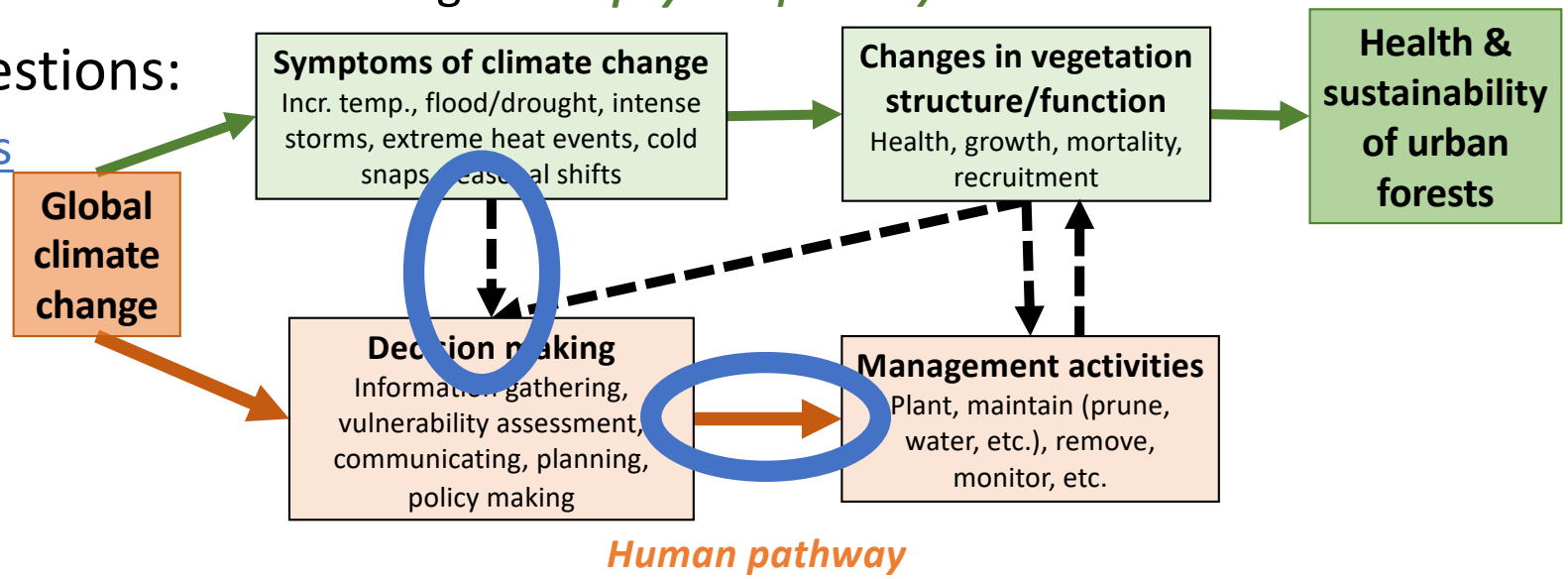
- So we ask two sets of questions:
  1. Responses to symptoms (i.e., experience)



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- But...there is a slight problem!
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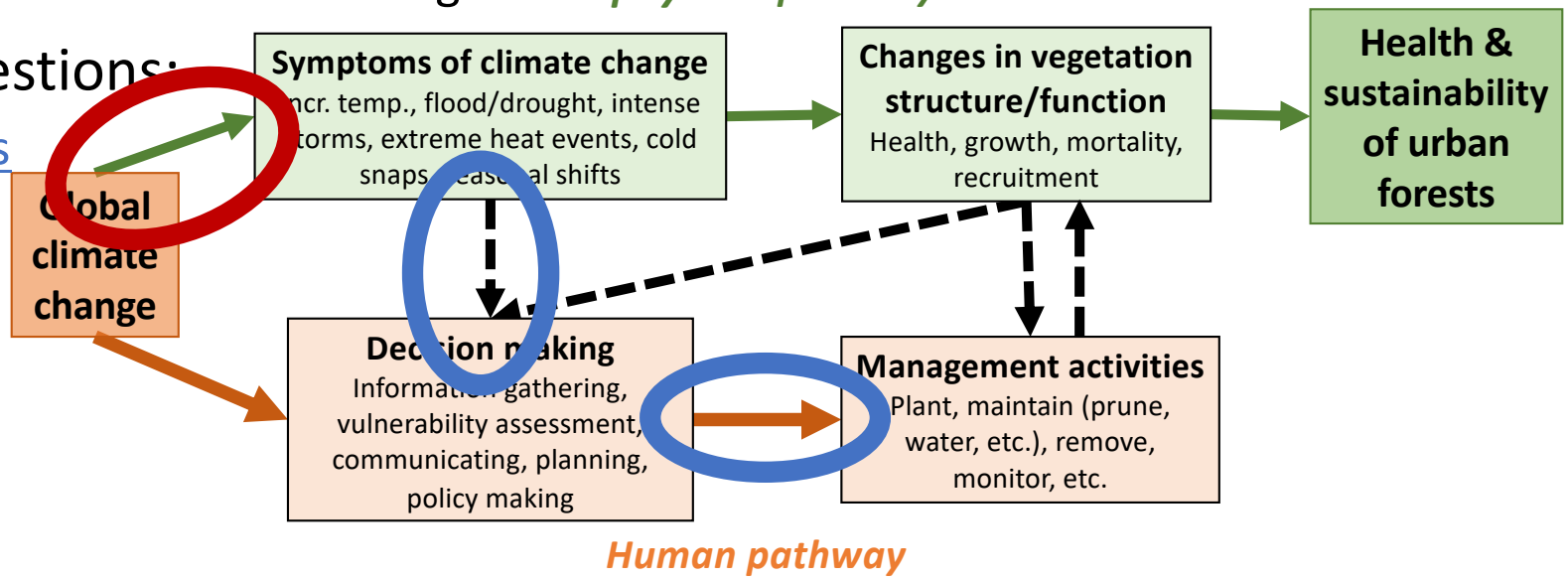
- So we ask two sets of questions:
  1. Responses to symptoms (i.e., experience)
  2. Knowledge of connections between symptoms & climate change



Survey of urban foresters

- Administered via urban forestry email lists in Chicago area (pilot of drought/flooding questions) and all of Canada (all 5 major symptoms)
- Asked about urban foresters experience with (i.e., response to) the symptoms of climate change:
  - Drought
  - Flooding
  - Intense storms
  - Extreme temperatures (heat + cold)
  - Seasonal shifts (earlier spring, later autumn)

Key experience question

Q28. Please indicate your level of agreement with the following statements regarding how **flooding** has impacted **how you manage** trees in the urban forest **within the past 5 years.**

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
Flooding has impacted the ***species or cultivars*** of trees we plant	○	○	○	○	○
Flooding has impacted the ***cost of planting*** new trees	○	○	○	○	○
Flooding has impacted ***where*** we plant new trees (types of ***planting areas/sites***)	○	○	○	○	○
Flooding has impacted ***when*** we plant new trees (***season*** or ***month*** of planting)	○	○	○	○	○
We now plant ***larger*** trees because of flooding	○	○	○	○	○

Key experience question (cont'd)

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
We now plant ***smaller*** trees because of flooding	○	○	○	○	○
Flooding has impacted the ***maintenance performed*** on ***newly planted*** trees	○	○	○	○	○
Flooding has impacted the ***maintenance*** (type, frequency of, etc.) performed on ***maturing or mature*** trees	○	○	○	○	○
Flooding has impacted the ***cost of maintaining existing trees*** (labour, etc.)	○	○	○	○	○
Flooding has impacted the ***people or groups*** we involve in the ***maintenance*** of trees (hiring, community outreach, etc.)"	○	○	○	○	○

Key knowledge question

Q13. Please indicate your level of agreement with the following statements.

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
Climate change plays a factor in the frequency and severity of **drought** in my region	○	○	○	○	○
Climate change plays a factor in the frequency and severity of **flooding** in my region	○	○	○	○	○
Climate change plays a factor in the frequency and severity of **intense storms** in my region					
Climate change plays a factor in the frequency and severity of **extreme heat** in my region					

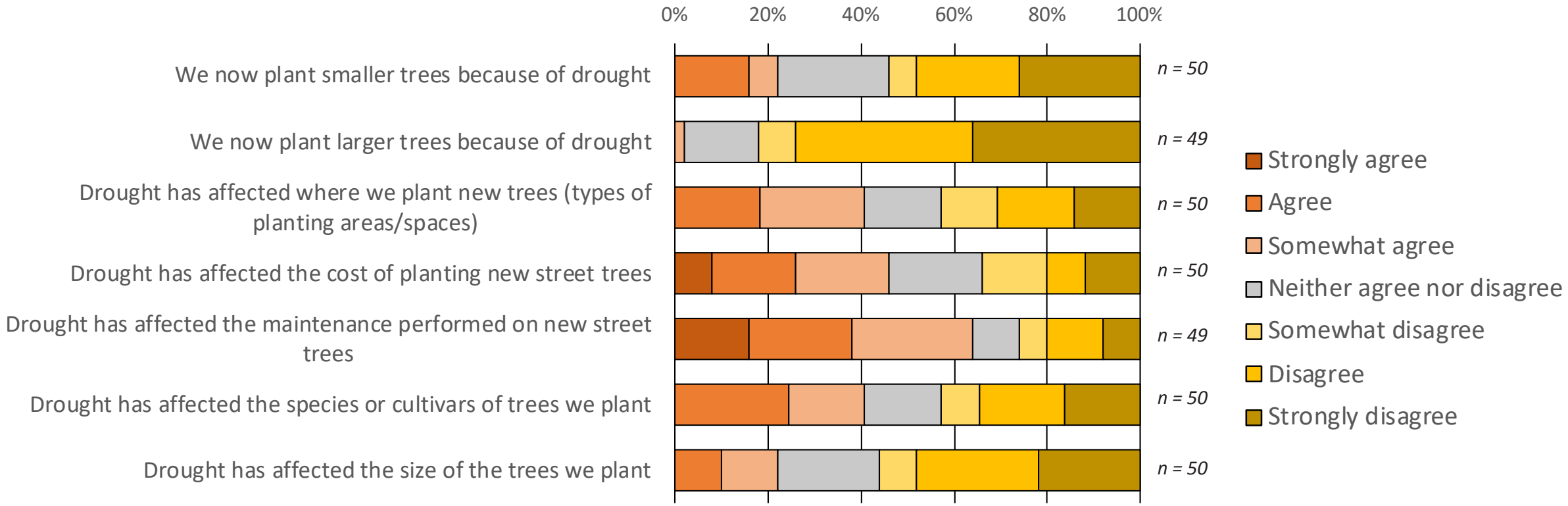
	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
Climate change plays a factor in the frequency and severity of **extreme cold** in my region	○	○	○	○	○
Climate change plays a factor in the frequency and severity of **seasonal shifts** in my region.	○	○	○	○	○
Climate change impacts the **survival and well-being** of the urban forest.	○	○	○	○	○

Chicago Results…

Select results presented herein.
(It was a long survey with a lot of data!)

Chicago urban foresters are sort of experience drought…

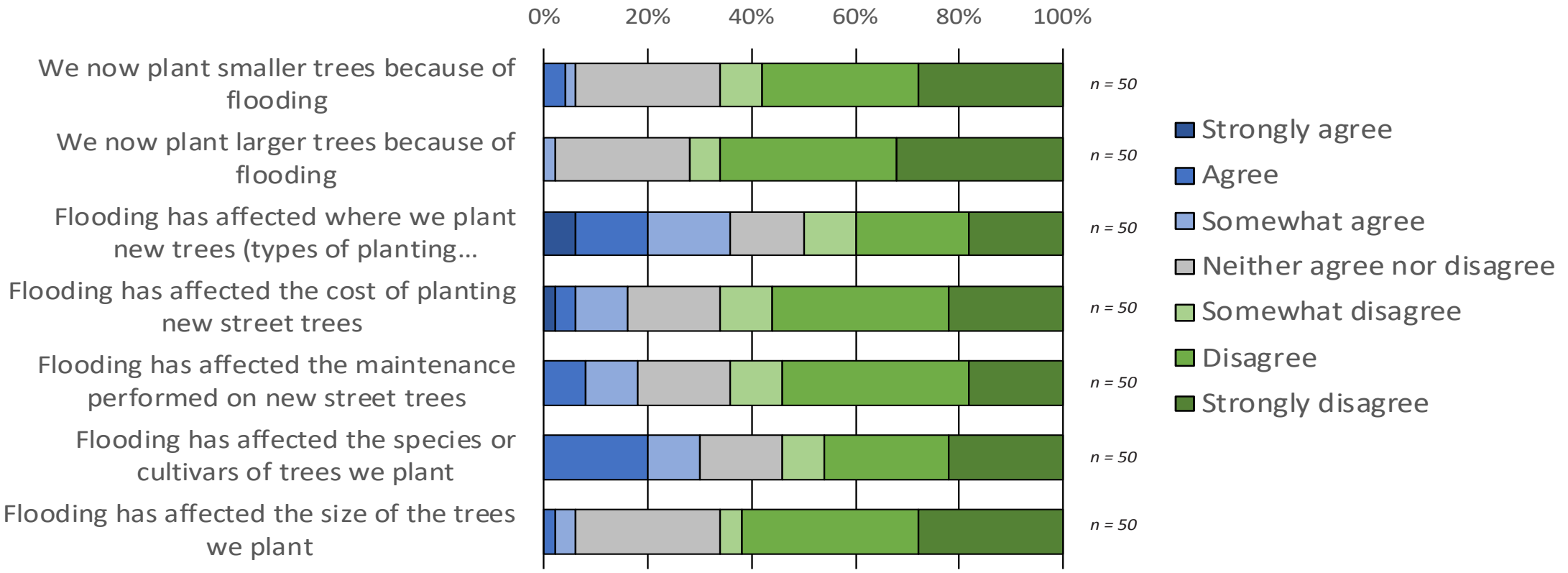
(especially as it impacts the maintenance of new street trees)



Vogt, Espeland, & Shoopmann, *manuscript in preparation*

Chicago urban foresters are not really experiencing flooding….

(except perhaps as it impacts species selection)



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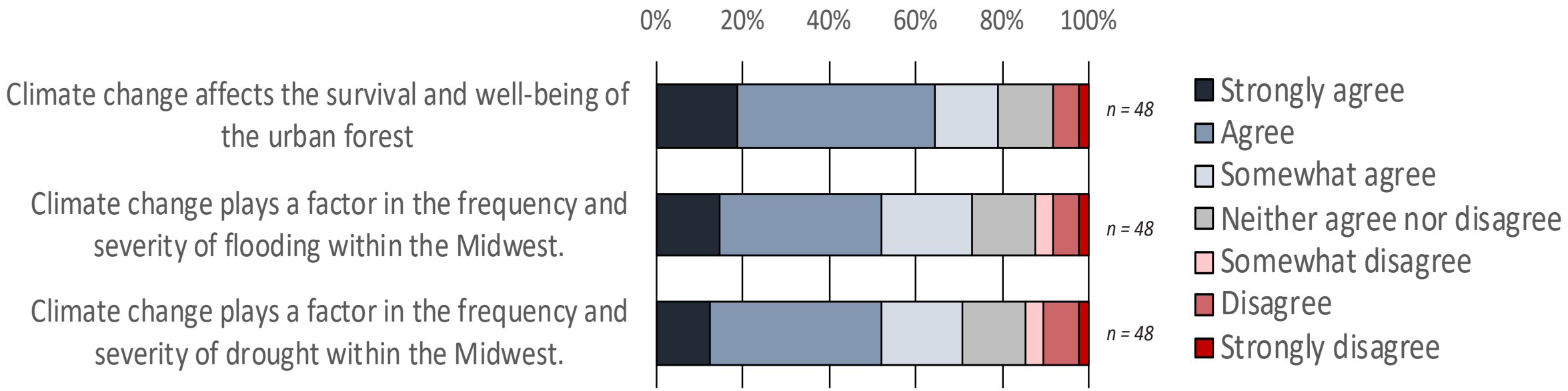
However…urban foresters think climate change has an impact on the urban forest…



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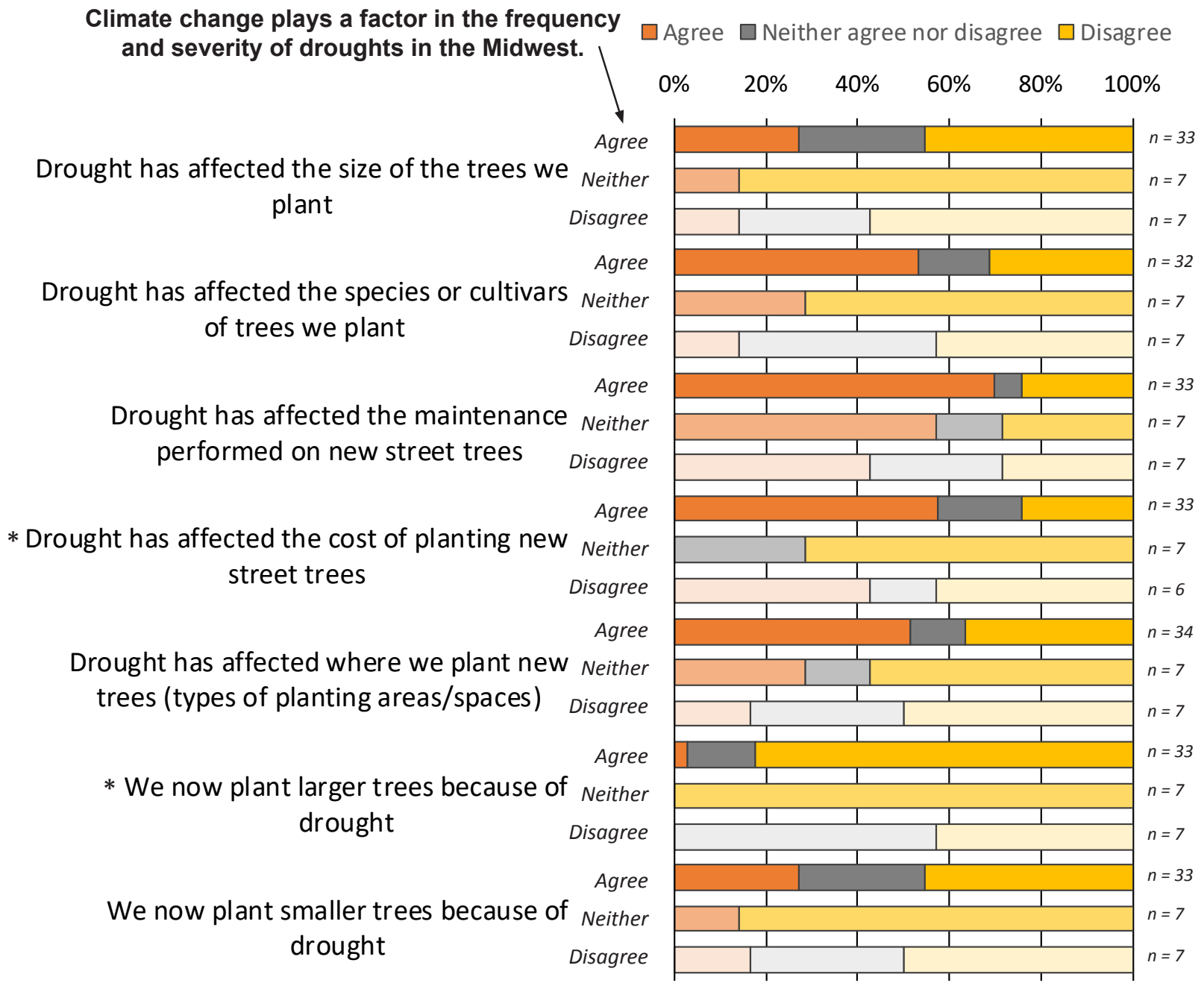
What if we combine experience with knowledge?

That is…does knowledge of the connection between the symptoms of climate change (drought, flooding) impact one's experience of (i.e., likelihood of taking action in response to) that symptom?

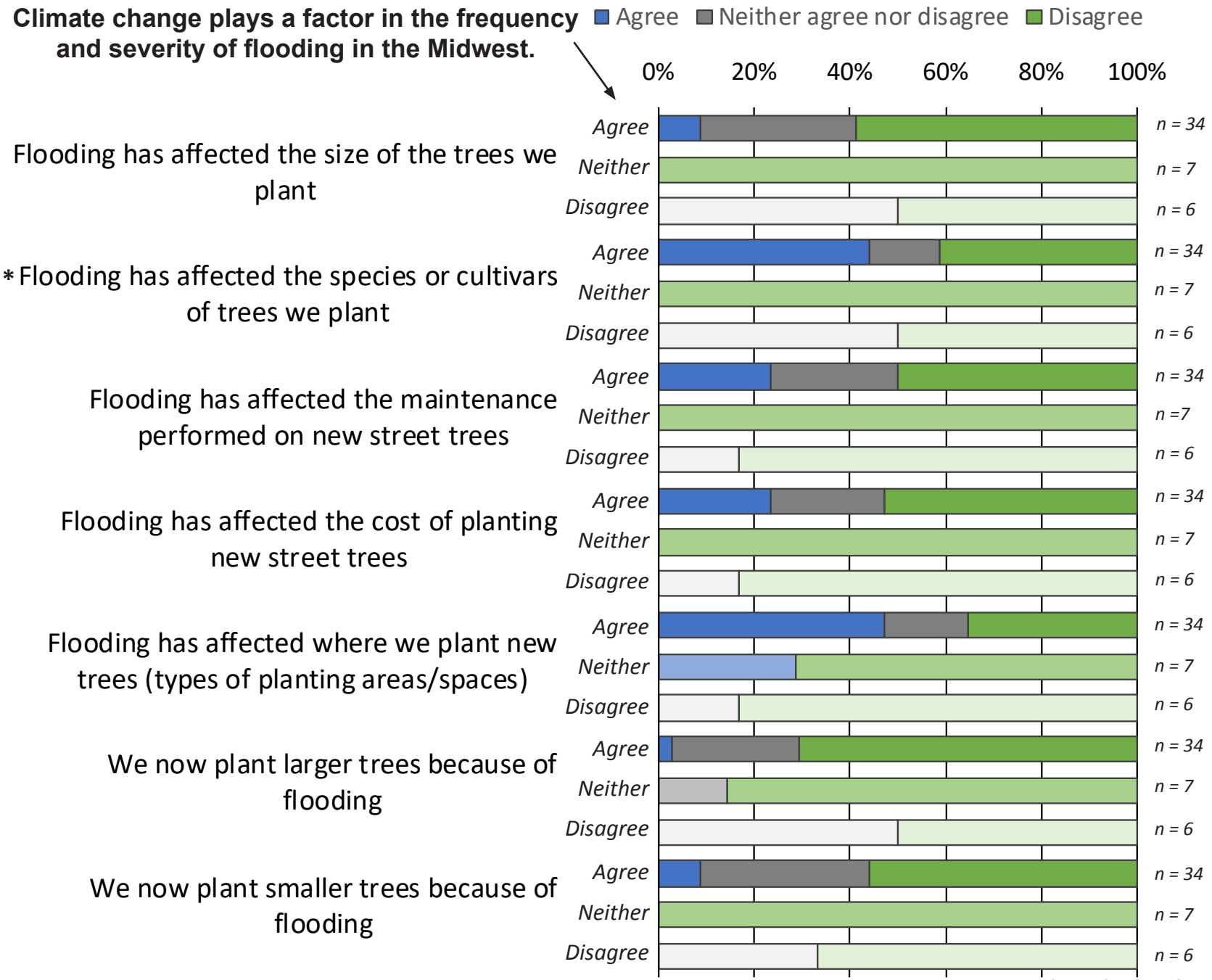


Does knowledge of <u>drought</u> impact experience of <u>drought</u>?

*Yes (significant impact)

Drought affects costs of planting (*likely more expensive)*
&
Drought does *not* incentivize planting larger trees

Vogt, Espeland, & Shoopmann, *manuscript in preparation*



Does knowledge of flooding impact experience of flooding?

*Yes (significant impact)

Flooding impacts species selection

Vogt, Espeland, & Shoopmann, *manuscript in preparation*

Canada Results…

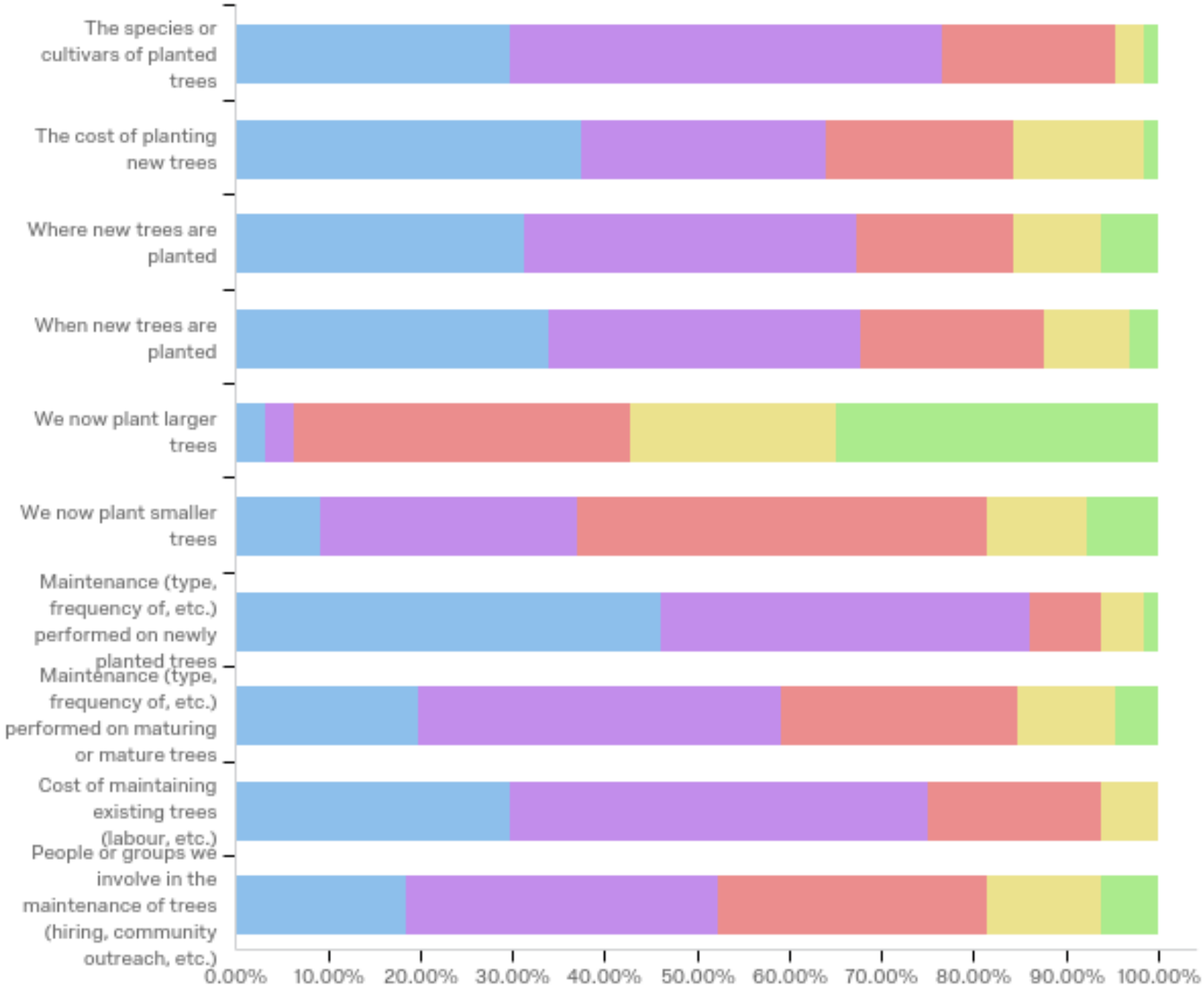
We wondered…what about other climate change symptoms aside from drought & flooding?

Ask Canadian urban foresters! (So as not to overtax the survey-taking goodwill of our Chicago urban forestry community.)

Partial-results presented in the following slides.
Data analysis still in progress…

Vogt, Shoopmann, Bardekjian, & Conway, *manuscript in preparation*

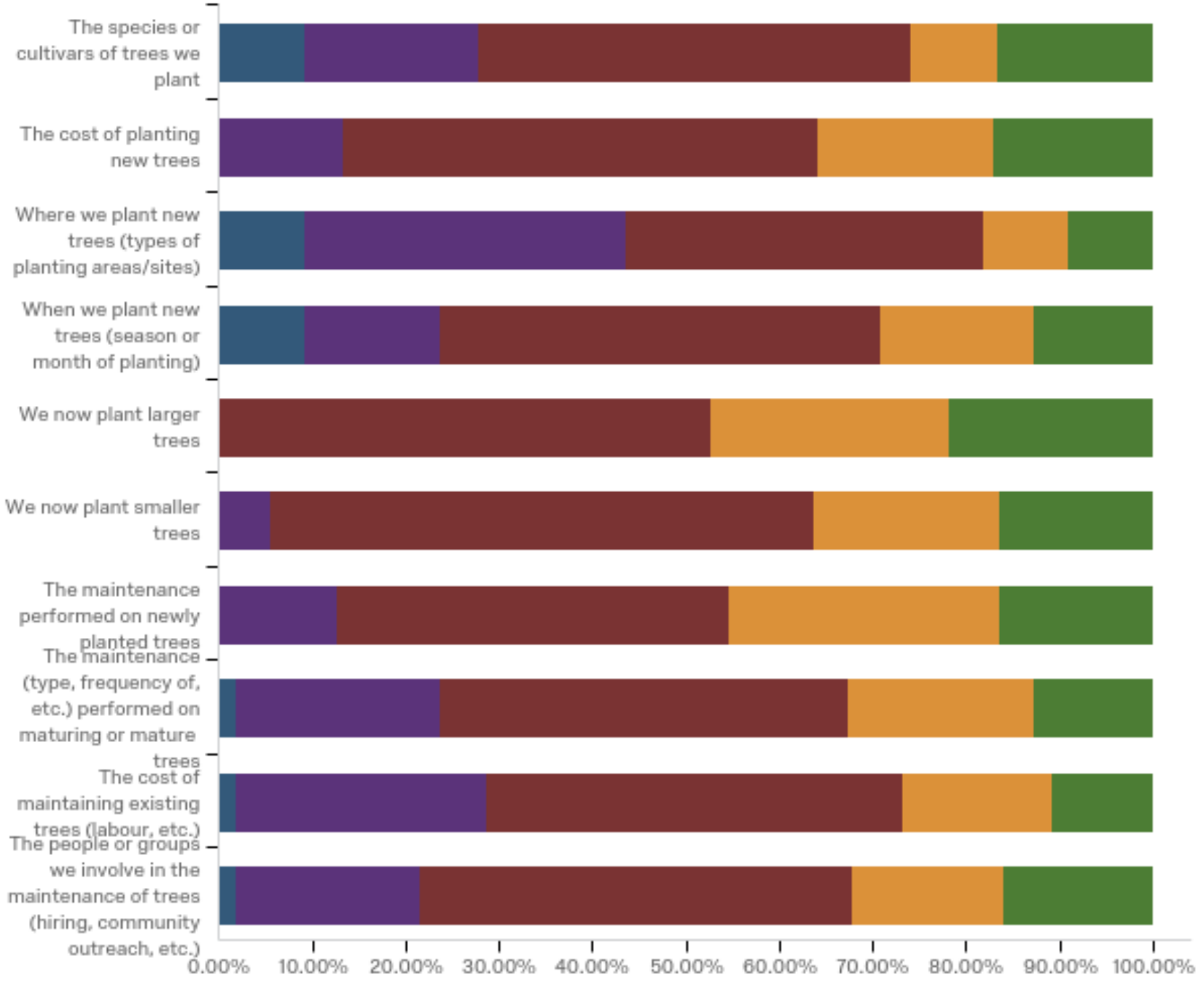
Results: Experience w/ **Drought** - Canada



More experience with drought than Chicago-area urban foresters

Vogt, et al., *manuscript in preparation*

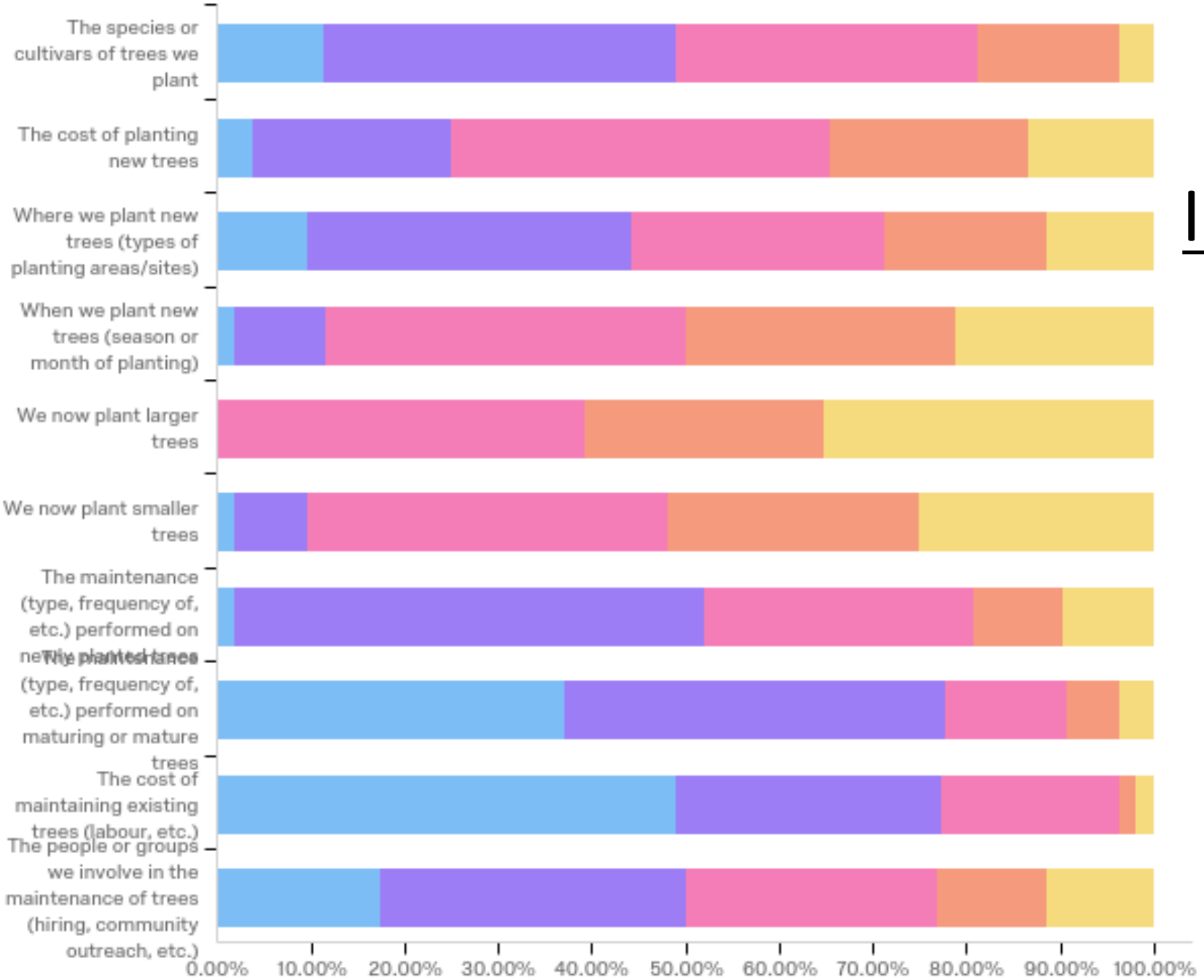
Results: Experience w/ **Flooding** - Canada



Not very much experience with flooding (same as Chicago-area) – lots of "neither" responses

Vogt, et al., *manuscript in preparation*

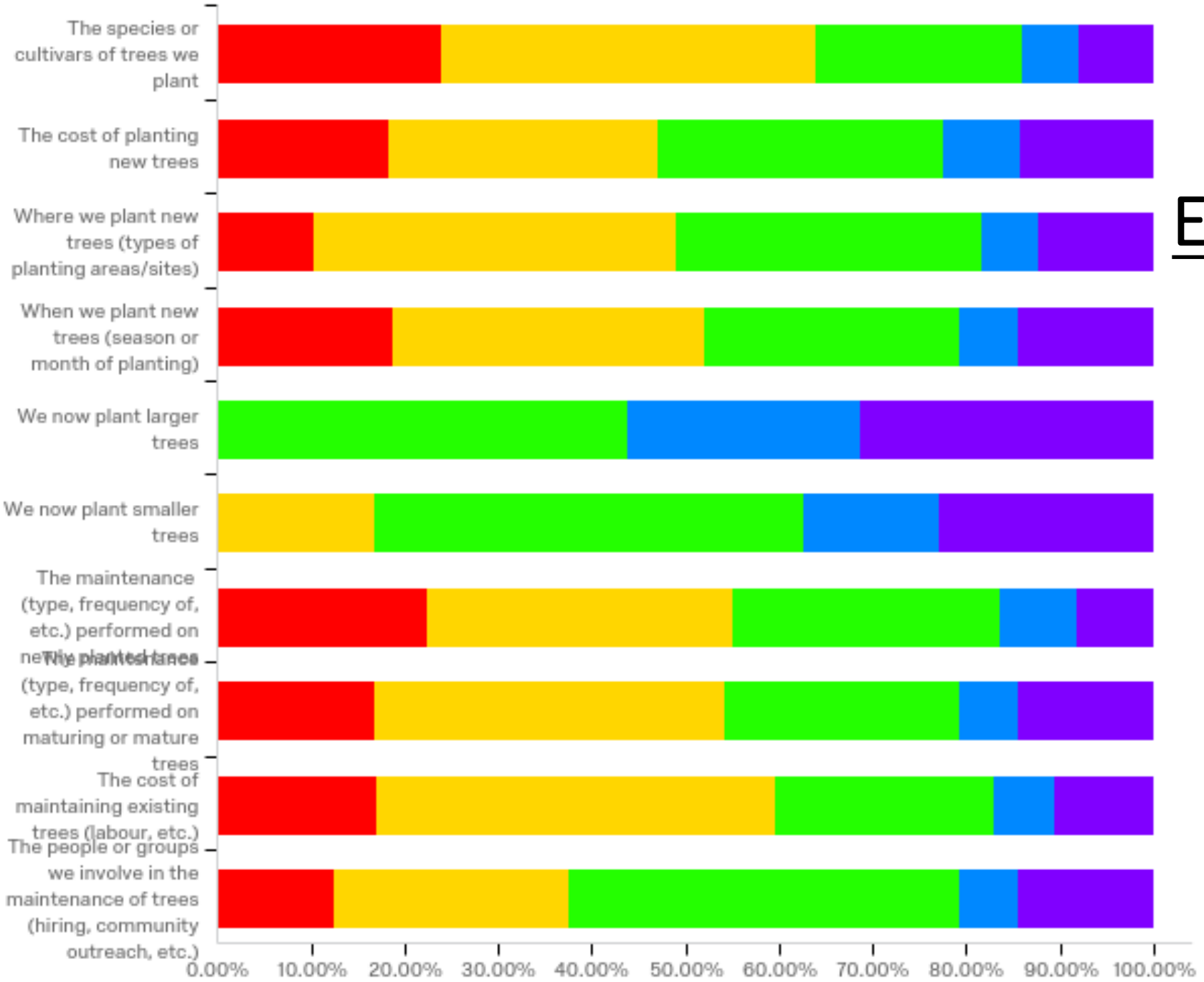
Results: Experience w/ Intense Storms - Canada



Intense storms impacts mature and existing tree activities but not newly planted trees

Vogt, et al., *manuscript in preparation*

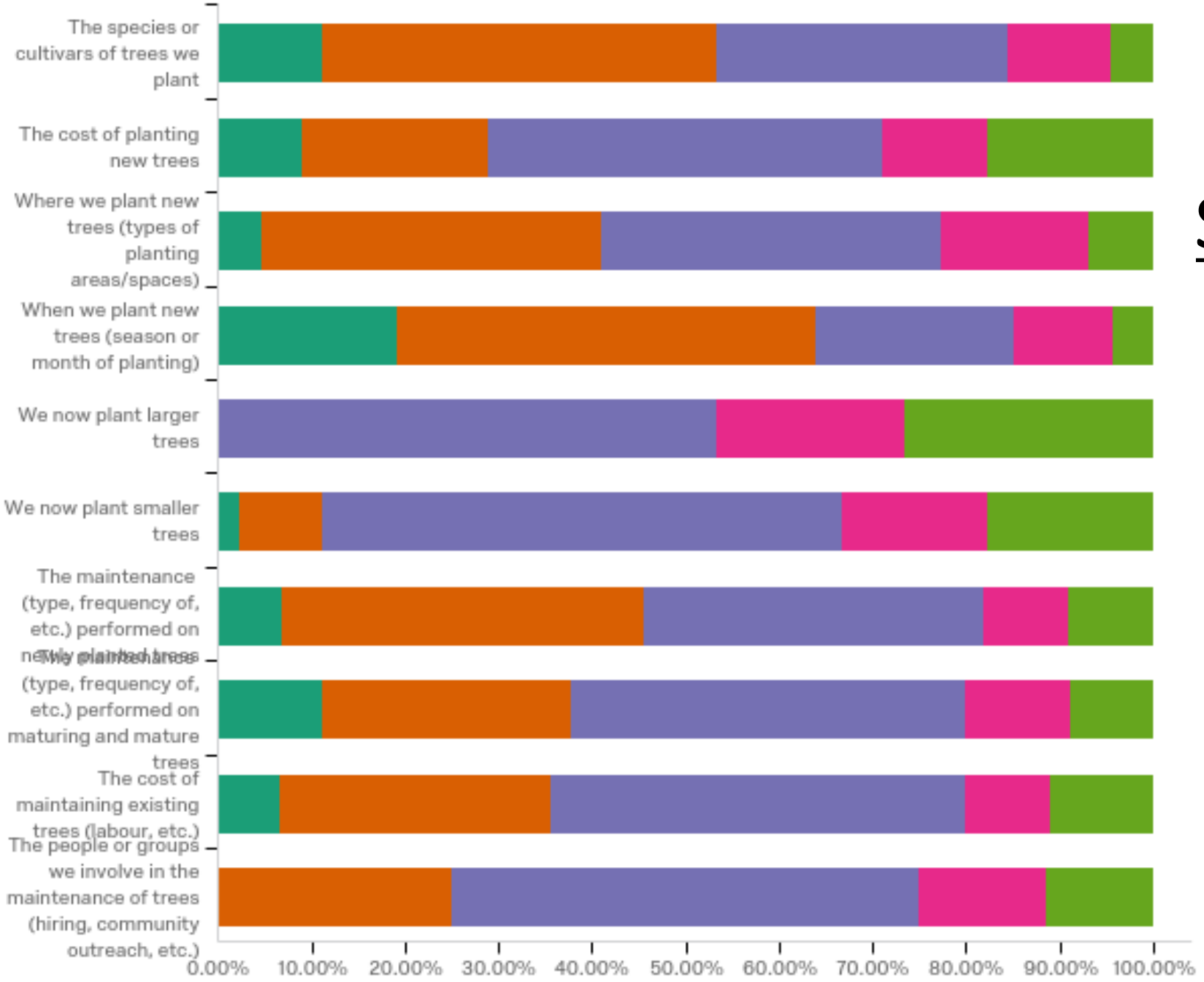
Results: Experience w/ **Extreme temps** - Canada



Extreme temps impacts everything except the size of planted trees

Vogt, et al., *manuscript in preparation*

Results: Experience w/ **Seasonal shifts** - Canada



Seasonal shifts have only a moderate impact - lots of ”neither” responses

Vogt, et al., *manuscript in preparation*

4. Next steps

Next steps

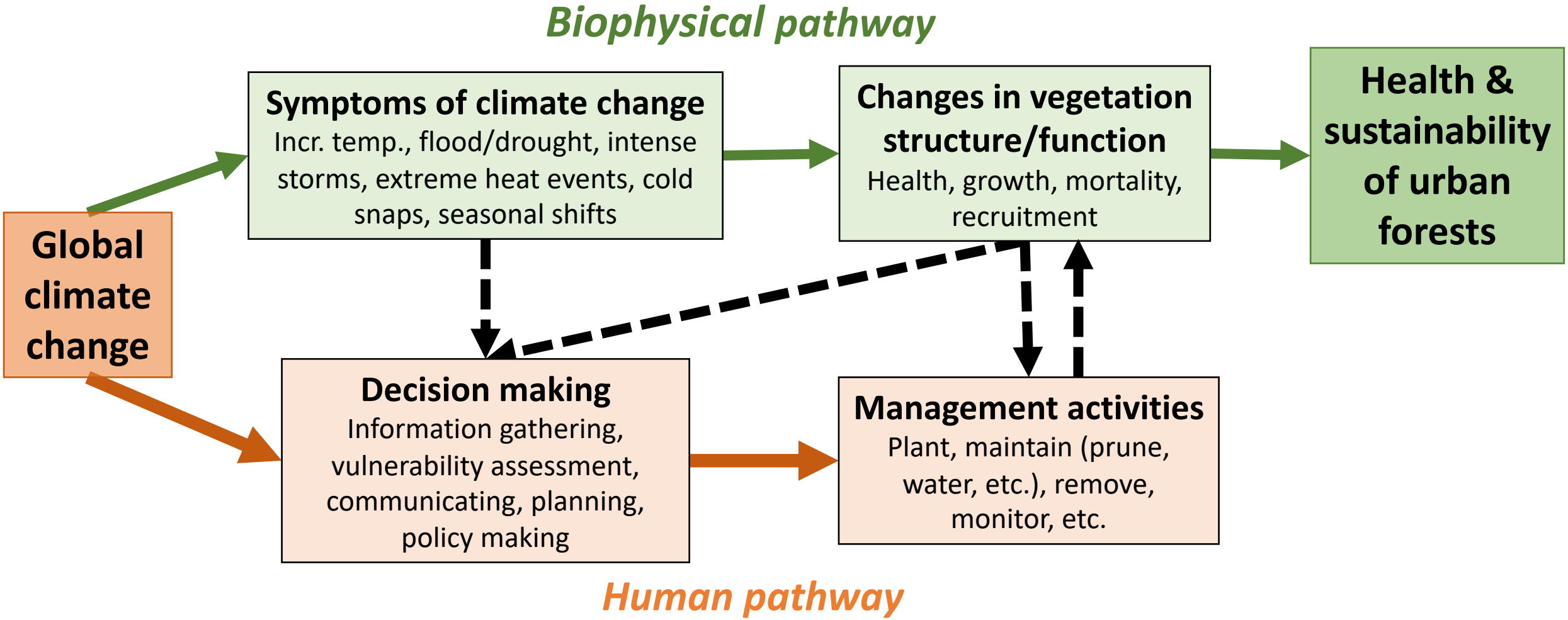
- Continue analysis of Canadian survey results, which we've only started working on this summer
- Refine/adjust survey questions – other symptoms to consider?
- Administer globally via International Society of Arboriculture

- Qualitative information
  - Survey only tells us quantitatively what people are doing
  - Open-ended questions: "Please describe **any particular changes** in how you manage trees - maintenance, removal, planting, species selection, etc. - that you've made in response to **drought.**"
  - Conduct in-depth interviews to assess experience of individual urban foresters

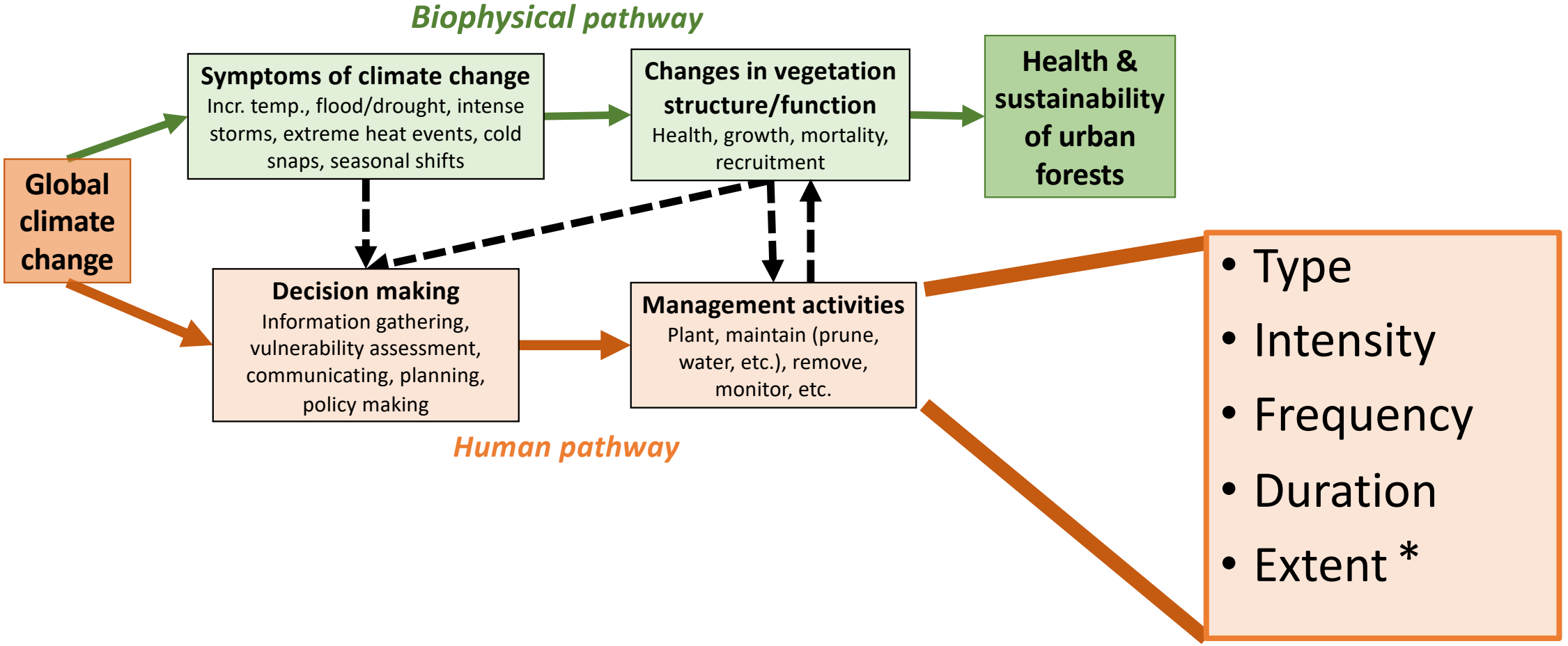
Knowledge & tools gaps

- What do urban foresters need to improve their ability to respond to climate change?
  - More knowledge?
  - More recommendations of what to do?
  - More tools to help decide what to do?
- Some of these exist…
  - E.g., U.S.-centric Urban Forest Climate Change Response Framework of the U.S. Forest Service's Northern Institute of Applied Climate Science
    - Detailed vulnerability assessment
    - Requires tree inventory data + extensive time and climate science expertise
    - Not for all (most?) municipalities
- What do urban foresters with limited resources want/need/have ability for?

More information about the Human Pathway!



How are maintenance strategies changing with climate change?



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Questions?

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