Forest Health Biotechnologies: What are the Drivers of Public Acceptance?

Mark D. Needham, PhD
Glenn T. Howe, PhD
Joshua Petit, PhD Student

Forest Health Initiative
Advancing Forest Health Through Biotechnology

U.S. Endowment for Forestry and Communities

Oregon State University OSU

Background: FHI Call for Proposals

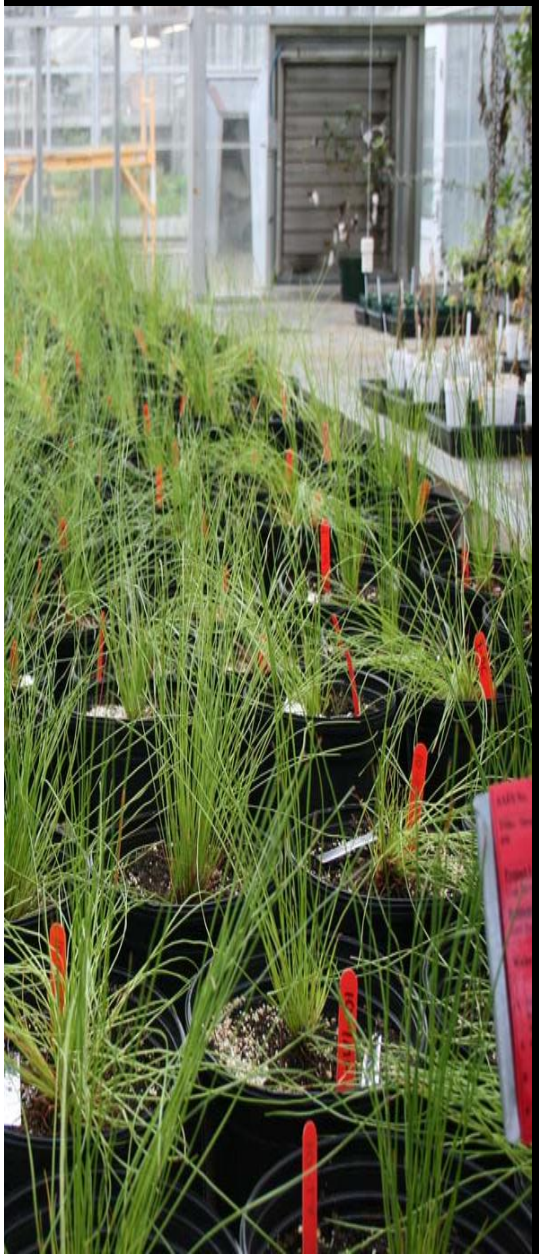
- Stakeholder views of biotechnologies as tools for improving forest health
- Public & experts (e.g., agencies, scientists, NGOs)
- Perceived impacts of diseases, pests, & climate on forests & desirability of biotechnologies to address
- "Spectrum of biotechnologies": other interventions beyond only genetic modification
- Drivers of perceptions (e.g., values, demographics)
- Information & language that may help people understand & inform decisions (message framing)

Project Objectives

Measure extent that the public & experts:

- **Perceive the magnitude of 3 impacts on forests**
  - **Chestnut blight (tangible, main interest of study & FHI)**
  - **Climate change (less tangible & qualitatively different)**
  - **Forest management to increase growth / harvest (baseline "control" to compare)**
- **Support & oppose using biotechnological & non-biotechnological interventions for these impacts**
- **Possess other factors that could serve as "drivers" of these perceptions & attitudes (e.g., values, risk perceptions, knowledge, demographics)**
- **Are influenced by message information & framing**

Project Objectives



Example interventions to mitigate impacts

- **Genetic modification (i.e., biotechnological)**

  …using modern laboratory approaches to change genes that are already present or add new genes from another organism. These new genes may come from closely related trees, other plants, or distantly related organisms such as bacteria...

- **Breeding (i.e., non-biotechnological)**

  …breeding involves selecting two parents of the same or different species, and then applying the male pollen from one tree to the female flower of another tree…

- **Traditional forest management (raised in focus groups; baseline "control" to compare)**

  …using common forestry techniques such as seeding, tree planting, and tree removal (thinning, harvesting)…

Example Hypotheses

- Support for interventions is higher for specific & tangible threats (e.g., chestnut blight) than general & less tangible threats (e.g., climate change)
- Support for intervention methods varies, with lowest for genetic modification from distantly related species
- Support for interventions, especially genetic modification, is influenced by drivers such as environmental values, perceptions of risk, & demographic characteristics
- Support for interventions increases when scientific information is provided (e.g., examples, benefits)
- Information framing using pejorative vs. positive terms influences support (e.g., irreversible release, biodiverse)

Methods: Phase I

- **Literature review completed & keep updating**
- **Three web-based & in-person focus group meetings with *n* = 26 participants from agencies, NGOs, academia, institutes, & industry**
- **Results informed questionnaire development & sampling for Phase II, & will also inform Phase III to ensure captures the main issues of interest**
- **Results presented at last year's meeting**

Methods: Phase II

Rigorous survey of 2 groups:

1. **Public across the U.S.**
   - **"*Public Chestnut*": Residents of counties most affected (Forest Inventory Analysis & GIS data focusing on areas of importance for chestnut)**
   - **"*Public General*": Residents of all other counties in the continental US**
   - **Random samples from recent postal & tax records**

2. **"*Experts*": From focus groups & multiple databases (e.g., CAFS, SFTIC, WFGA)**
   - **Academics / university scientists**
   - **Businesses involved in forests / forestry**
   - **Government agencies (local, state, federal)**
   - **NGOs (e.g., associations, societies, alliances, foundations)**

Methods: Phase II

- Questionnaires extensively reviewed for validity (e.g., FHI, focus group members, other experts)
- Pre-test & debriefing with public & students
- Six contacts between January & June 2015 (much more than usual, cannot do more [budget, IRB])
  - Postcard notification with option to complete online
  - Full mailing
  - Postcard reminder with option to complete online
  - Personal telephone call emphasizing importance
  - Full mailing
  - Full mailing (responses still coming in)

Methods: Phase II

	Sample size (*n*)	Response rate (%)	Margin of error at 95% CI
Public	275 (*goal: 400+*)	11 (*goal: 20%+*)	± 5.9% (*goal: ± 5% or less*)
Experts	191 (*goal: 200*)	32 (*goal: 30%+*)	± 5.0% (*goal: ± 5% or less*)
Total (responses still coming in)	466	15	± 4.5%

- Potential limitation of low response among public, so large (*n* = 107) telephone nonresponse bias check to examine representativeness of public sample
- No statistical differences & tiny effect sizes (i.e., strength), so appears representative; also comparing to US Census

Preliminary Results: Forest Threats

Percent (%) "moderate threat" or "extreme threat"

	Public General	Public Chestnut	Experts	Total	χ^2 value	Cramer's *V*
Clearing for urban development (roads, houses)	90	96	95	94	4.59	.11
Insects (e.g., pine beetle, emerald ash borer)	91	83	95	90	11.75**	.17
Other tree diseases (e.g., blister rust, Dutch elm)	91	89	91	90	0.54	.04
Invasive species (exotic, non-native)	82	84	89	86	3.05	.08
Chestnut blight (a tree disease)	89	89	72	82	20.13***	.22
Mining	84	92	73	82	17.71***	.20
Clearing for farms or ranches	83	83	78	81	2.04	.07
Forest fires	81	81	73	78	3.34	.09
Oil or gas exploration	84	88	66	78	26.42***	.25
Acid rain	80	84	65	75	16.44***	.20
Climate change	70	73	66	69	1.96	.07
Commercial timber harvesting (logging)	75	84	25	57	133.17***	.55
Over-browsing by wildlife	33	44	57	46	18.53***	.21
Recreational activities in forests	43	43	32	38	5.71	.12

*** $p < .001$, ** $p < .01$, * $p < .05$ (i.e., statistically significant difference among the 3 groups)

Cramer's *V* effect size: .10 = minimal / small, .30 = typical / medium, .50 = substantial / large strength of difference

Preliminary Results: Knowledge

61% heard of chestnut blight : 23% general public, 50% public chestnut, 96% experts

$\chi^2 = 208.76$, $p < .001$, $V = .64$

Percent (%) correct

	Public General	Public Chestnut	Experts	Total	χ^2 value	Cramer's *V*
Killed almost all chestnut trees in North America (T)	70	73	87	82	8.20*	.18
Is caused by a fungus (T)	60	53	95	81	59.75***	.49
Most commonly found in eastern region of USA (T)	67	63	88	80	19.44***	.28
Only affects young chestnut trees (F)	62	55	88	78	31.79***	.36
Caused by insect infestation in trees (F)	47	47	89	75	53.82***	.46
First found in USA in 1975 (F)	45	53	82	71	28.04***	.33
Has no known cure (T)	40	57	82	71	27.63***	.33
Thought to have been introduced from Asia (T)	52	57	77	70	13.63***	.23
Affects all species of chestnut trees in the world (F)	37	46	75	64	27.04***	.32
Generally enters through wounds / cracks in bark (T)	57	41	70	62	15.59***	.25
Total (% correct out of 10)	54	53	83	73	41.41***	.50

Preliminary Results: Beliefs

Percent (%) agree

	Public General	Public Chestnut	Experts	Total	χ^2 value	Cramer's *V*
Chestnut trees are important to natural heritage of country	79	89	94	91	6.30*	.17
It is important to see healthy chestnut trees in forests	85	90	88	88	0.31	.04
It is important to restore chestnut trees to their native range	77	88	77	80	3.21	.11
Humans should manage chestnut blight to reduce impacts	89	69	80	79	5.06	.14
Chestnut blight is something we should be concerned about	79	86	77	79	2.17	.09
Humans should find ways to change trees so not affected	65	58	74	70	5.59	.15
Chestnut blight is a disaster to forests	73	72	62	66	2.52	.10
Scientific knowledge about chestnut blight is incomplete	74	64	61	63	1.95	.09
I trust government to minimize impacts of chestnut blight	42	36	49	45	2.75	.10
I trust companies to minimize impacts of chestnut blight	27	36	38	36	1.19	.07
Risks of chestnut blight are mostly unknown	28	27	9	15	13.63***	.24
Chestnut blight is a naturally occurring condition in trees	7	24	10	13	6.59*	.18
I do not care, as there are almost none remaining in country	7	4	12	10	4.27	.10
Humans should take no action & let it take its natural course	4	14	3	6	8.31*	.20

Scenarios

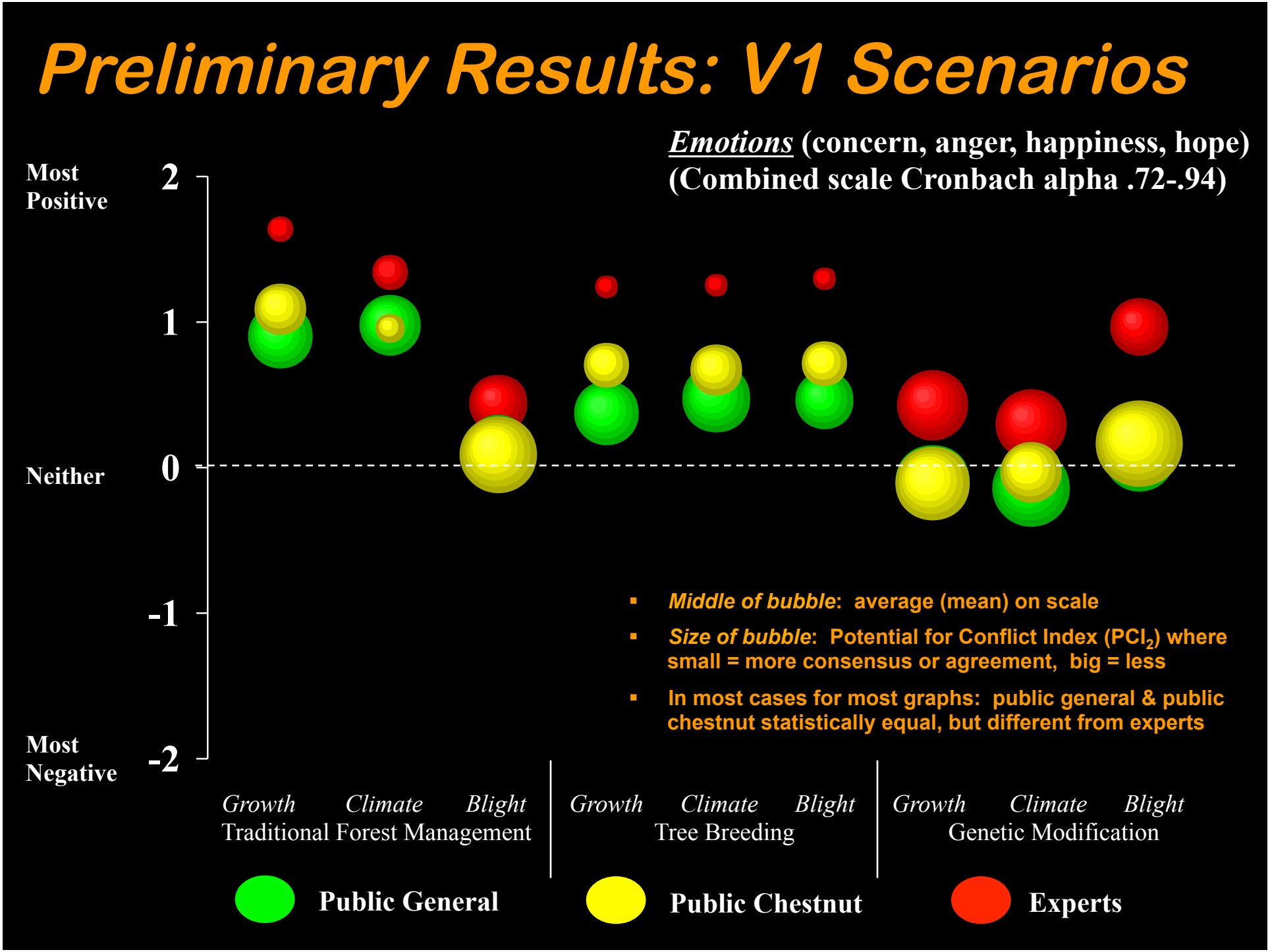
- 2 survey versions because of length & burden; each respondent received 1 version
- *Version 1*: 3 impacts * 3 interventions = 9 scenarios
- Impacts (chestnut blight relative to other impacts):
  - Chestnut blight (main study & FHI interest)
  - Climate change (qualitatively different & asked in RFP)
  - Increasing forest growth for economic / harvest (control)
- Interventions:
  - Tree breeding (non-biotechnological)
  - Genetic modification (biotechnological)
  - Traditional forest management (e.g., plant, thin) (control)

Scenarios

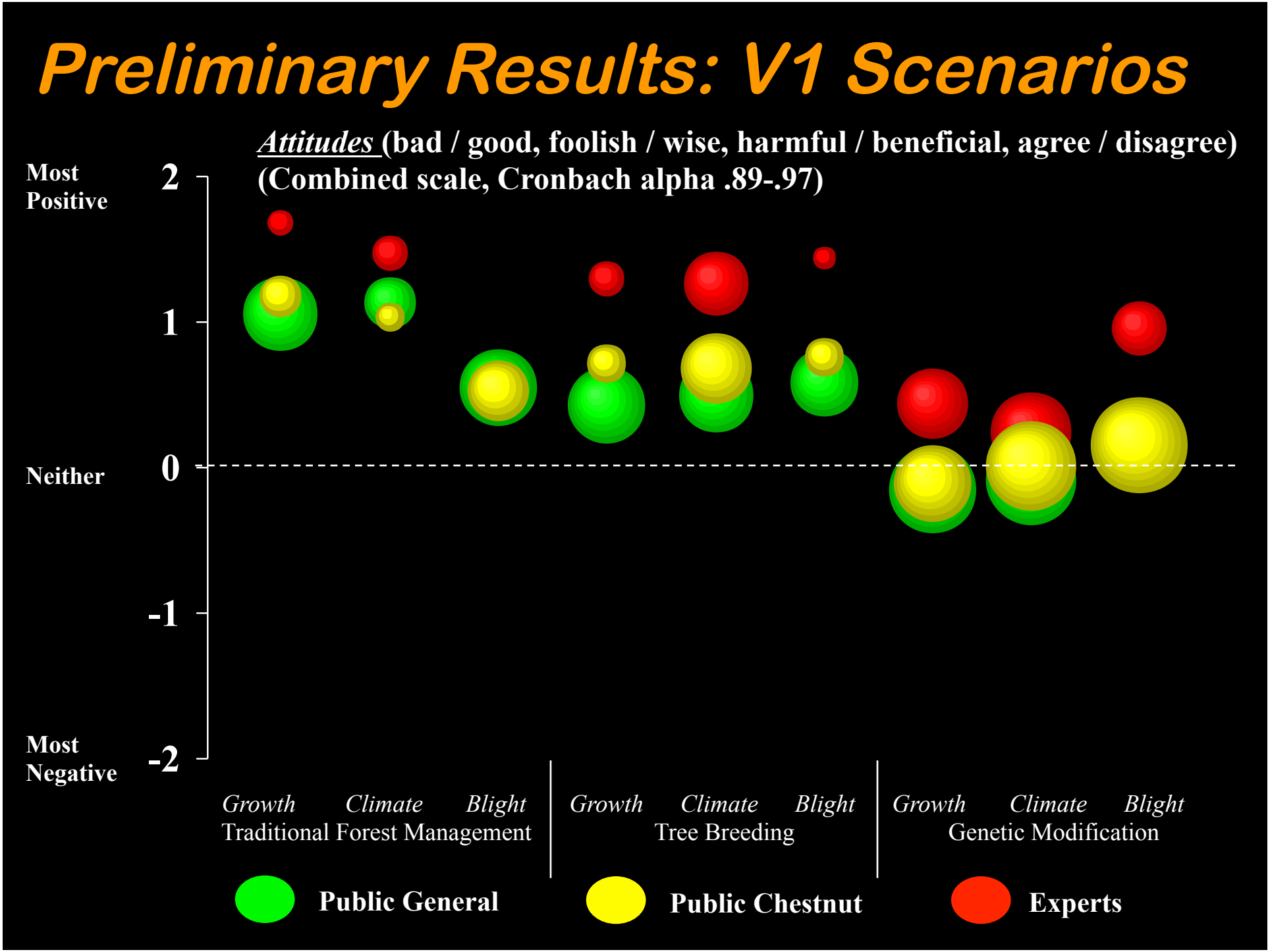
Questions following each scenario:

- **Emotions (e.g., angry, not concerned, optimistic)**
- **Attitudes (e.g., good, bad, agree, disagree)**
- **Norms (i.e., what “should” or “ought” to do or not do)**
- **Behavioral intentions (vote to support, oppose)**
- **Perceived benefits (who / what would benefit)**
- **Perceived risks (who / what would be at risk)**
- **Appropriateness on lands (public, private) (version 1)**
- **Beliefs about possible negative impacts (version 2)**

Preliminary Results: V1 Scenarios



Preliminary Results: V1 Scenarios



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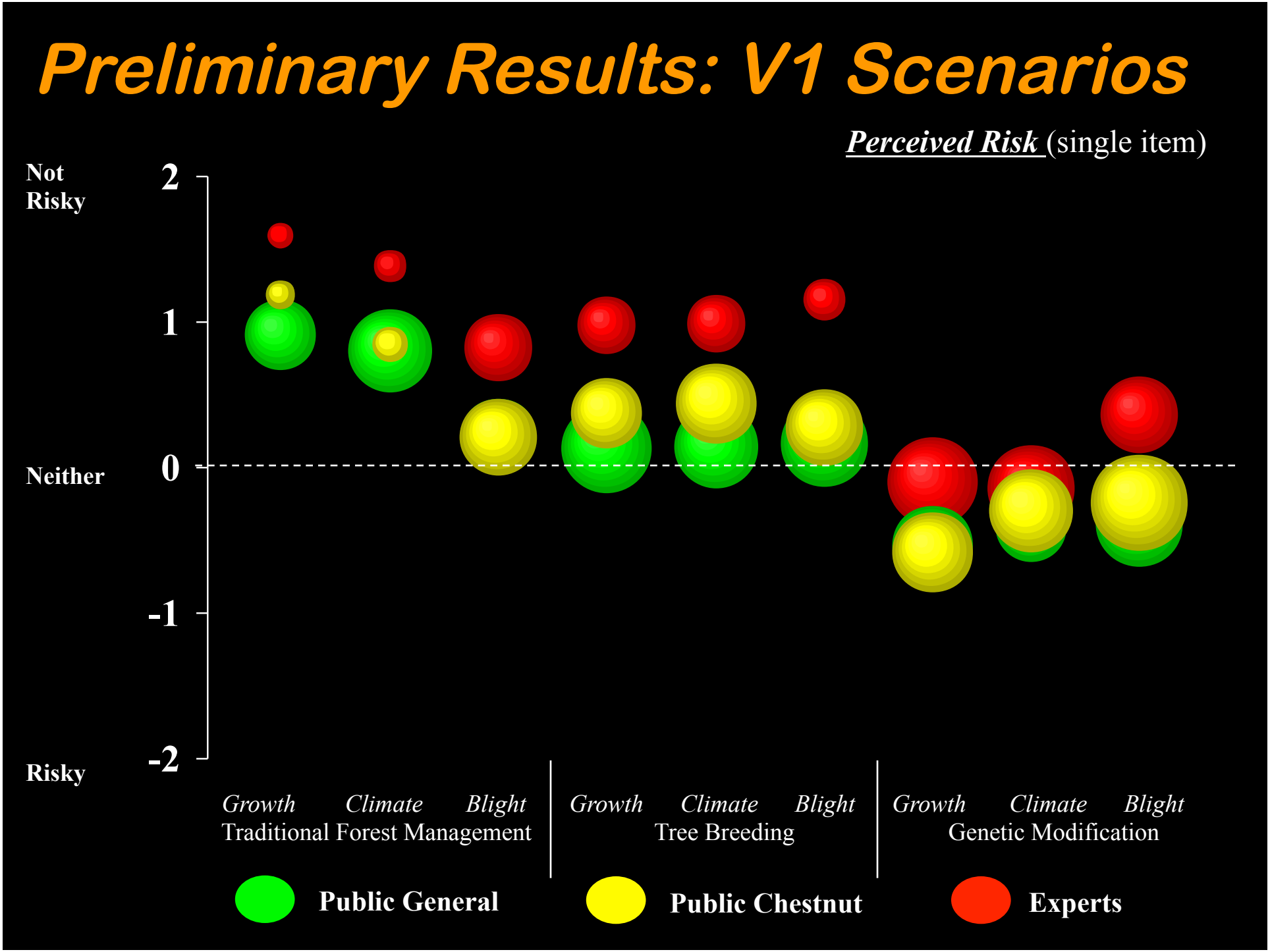

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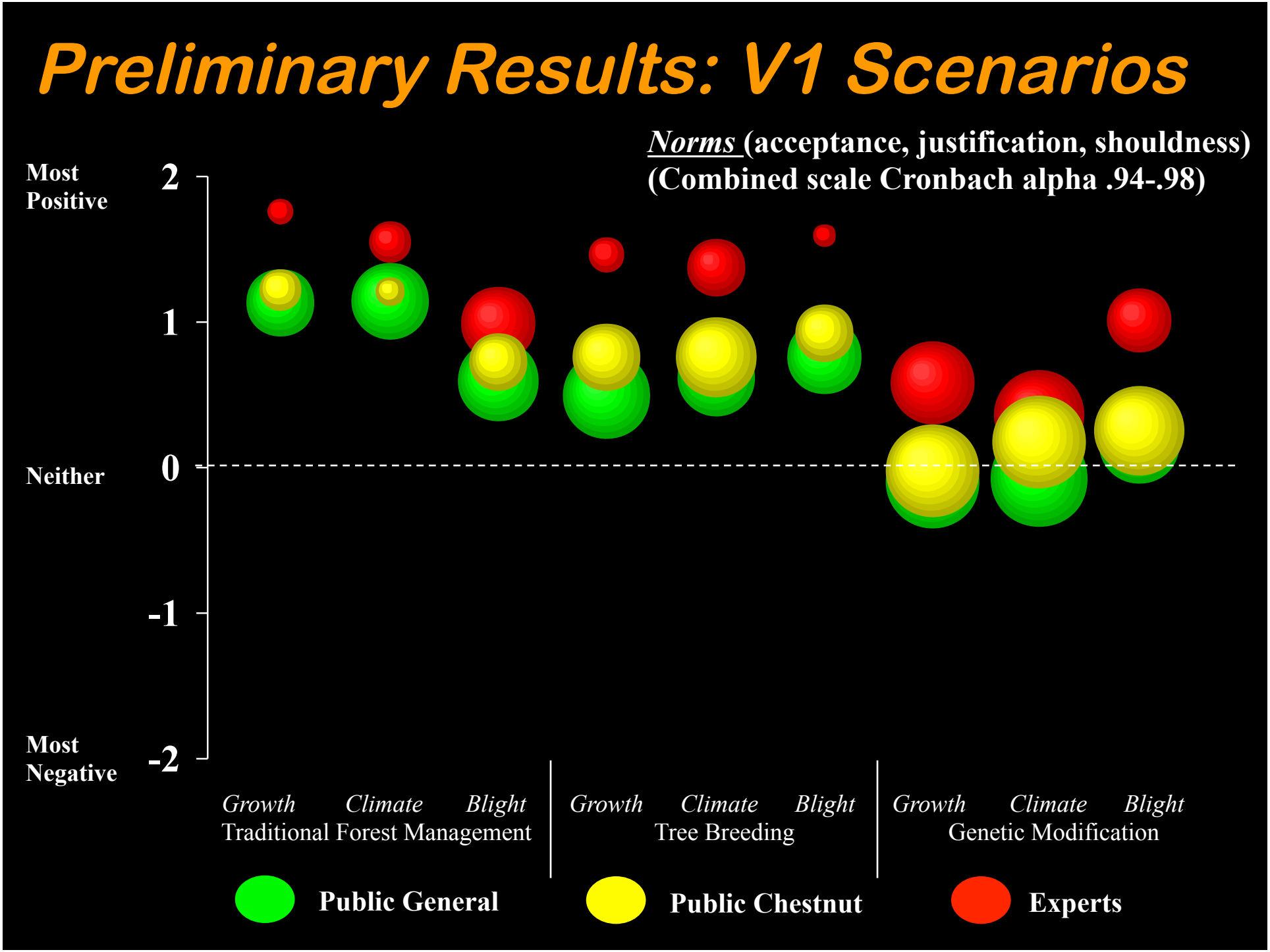


Preliminary Results: V1 Scenarios

Behavioral Intention (single item)

"If you were given an opportunity to vote for or against the scenario, how would you vote?"

Percent (%) vote "For" (i.e., in favor)

	Public General	Public Chestnut	Experts	Total	χ^2 value	Cramer's *V*
Increasing forest growth (to help increase forest growth…)						
Traditional forest management	84	92	99	92	11.83**	.24
Tree breeding	60	78	97	81	32.16***	.39
Genetic modification	43	55	62	55	5.04	.16
Climate change (to help forests adapt to climate change…)						
Traditional forest management	79	92	96	90	10.52**	.24
Tree breeding	67	74	92	80	15.39***	.28
Genetic modification	45	58	55	53	2.29	.11
Chestnut blight (to help trees resist chestnut blight…)						
Tree breeding	77	88	97	89	12.84**	.26
Traditional forest management	73	78	79	77	0.91	.07
Genetic modification	53	64	81	68	13.01***	.26

Preliminary Results: V1 Scenarios

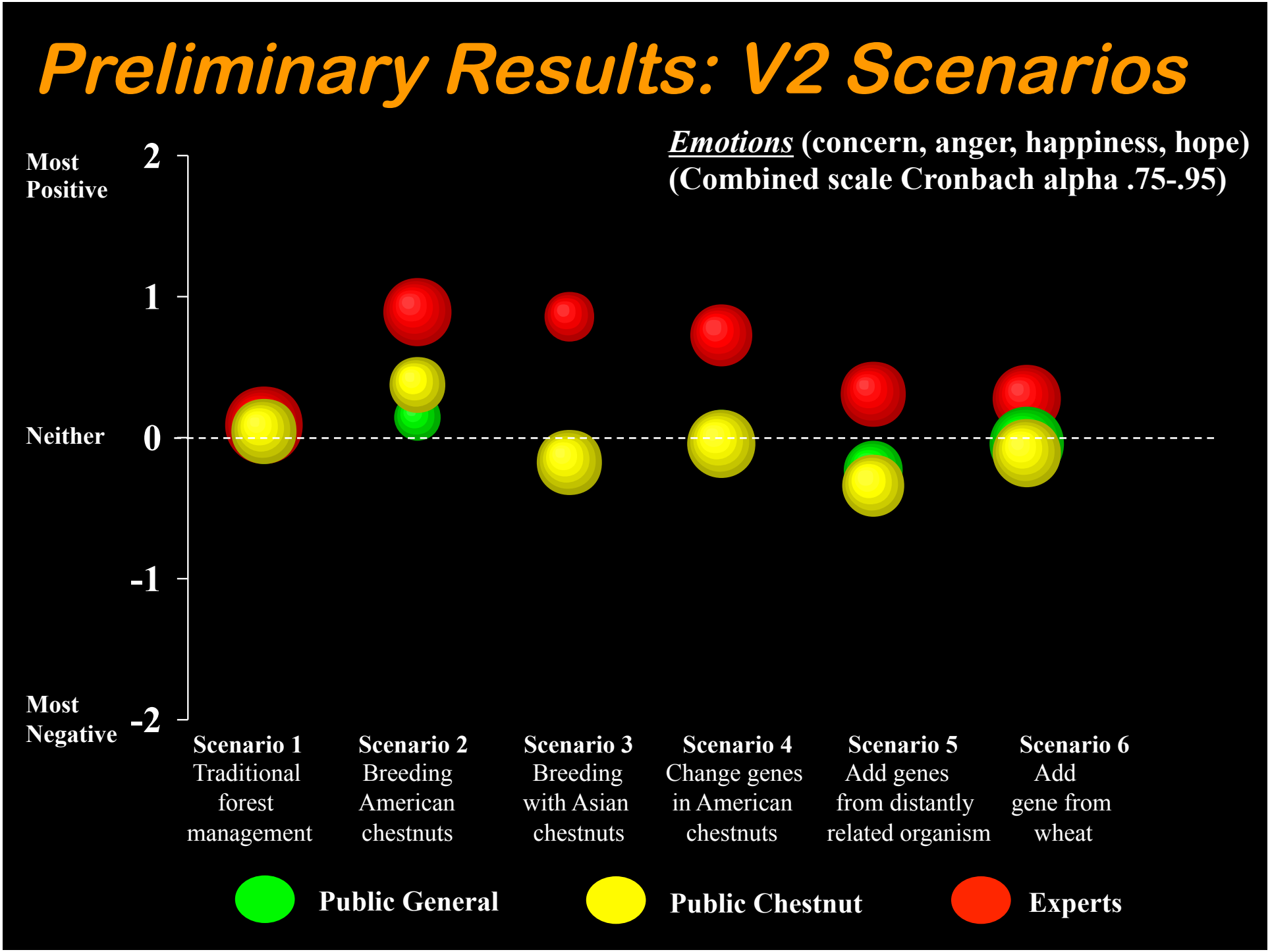
Conjoint Analysis – Percent (%) Averaged Importance

	Public General	Public Chestnut	Experts	Total
Emotions				
Impact (chestnut blight, climate change, forest growth)	39	41	37	39
Intervention (genetic, breeding, forest management)	61	59	63	61
Attitudes				
Impact (chestnut blight, climate change, forest growth)	36	36	37	36
Intervention (genetic, breeding, forest management)	64	64	63	64
Perceived risk				
Impact (chestnut blight, climate change, forest growth)	35	34	31	33
Intervention (genetic, breeding, forest management)	65	66	69	67
Norms				
Impact (chestnut blight, climate change, forest growth)	37	37	33	35
Intervention (genetic, breeding, forest management)	63	63	67	65
Behavioral intentions (voting)				
Impact (chestnut blight, climate change, forest growth)	41	39	34	38
Intervention (genetic, breeding, forest management)	59	61	66	62

Scenarios

- *Version 2*: 1 impact * 6 interventions = 6 scenarios
- Impact: chestnut blight only
- Much more specific interventions:
  - Tree breeding (non-biotechnological):
    - Breed 2 American chestnuts (within-species)
    - Breed American chestnut with non-native chestnut from Asia (between-species hybridization)
  - Genetic modification (biotechnological):
    - Change gene already present in American chestnut
    - Add new gene from distantly related organism
    - Add new gene from wheat
  - Traditional forest management (e.g., plant, thin) (control)

Preliminary Results: V2 Scenarios



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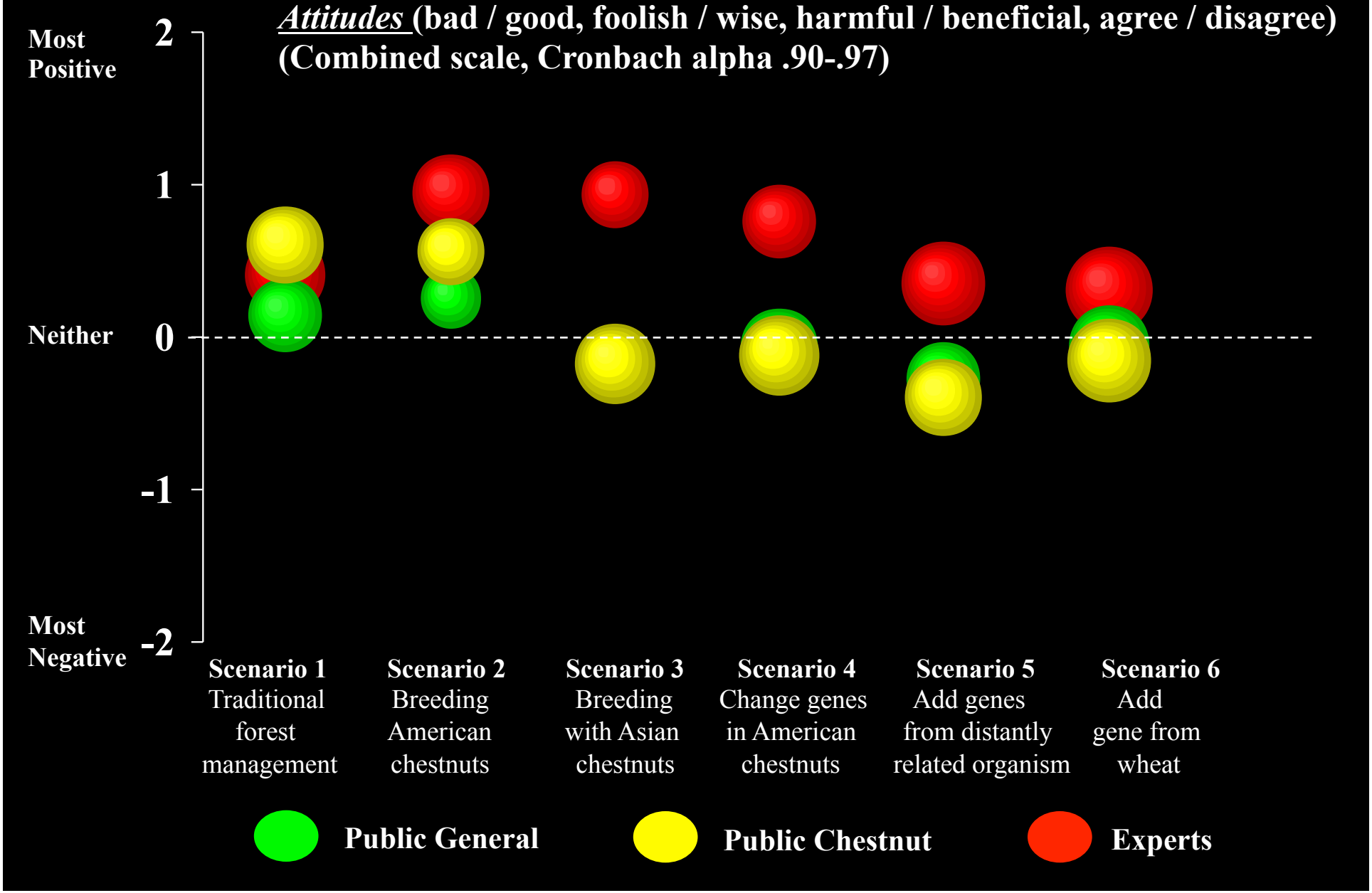

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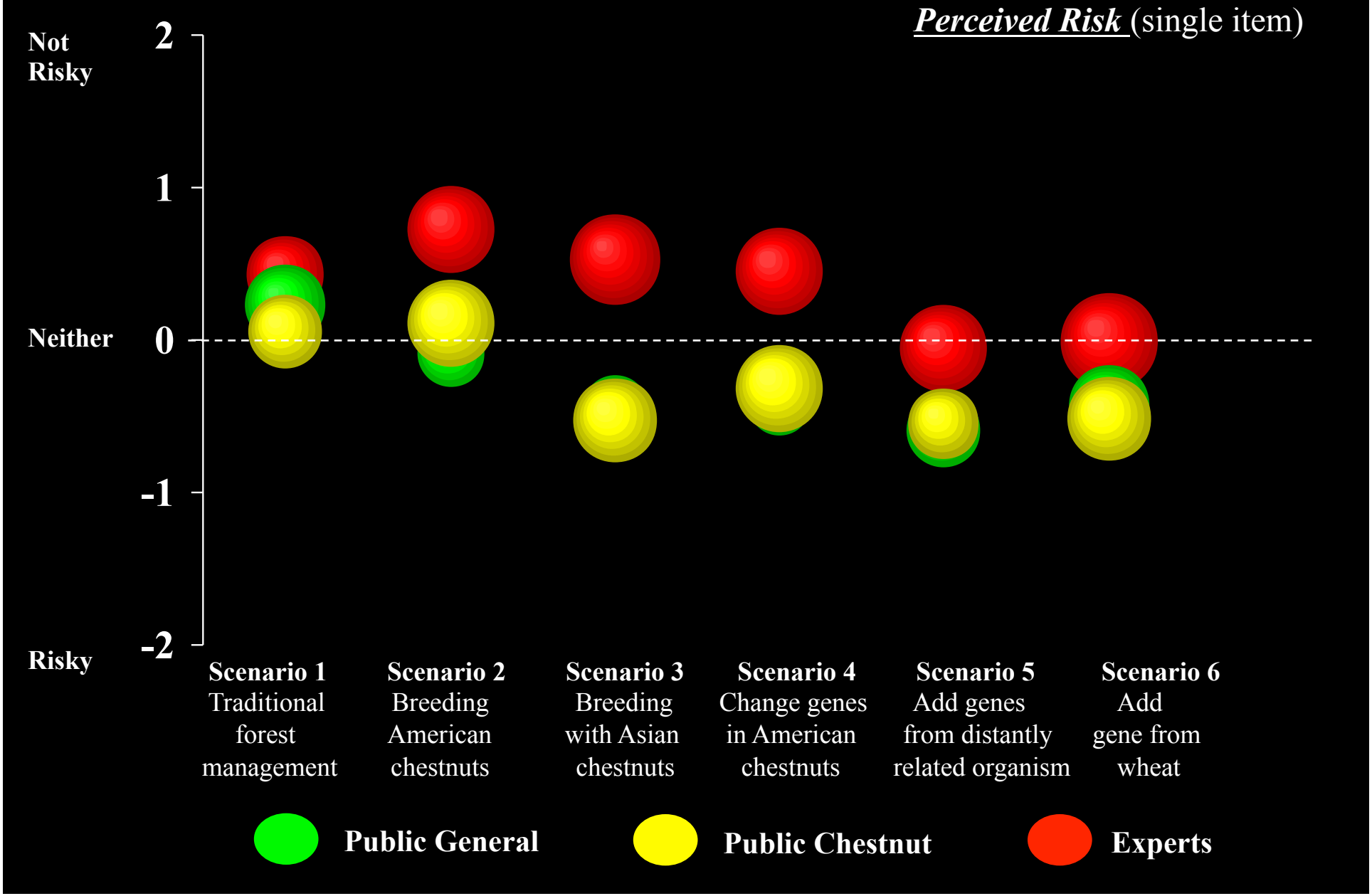

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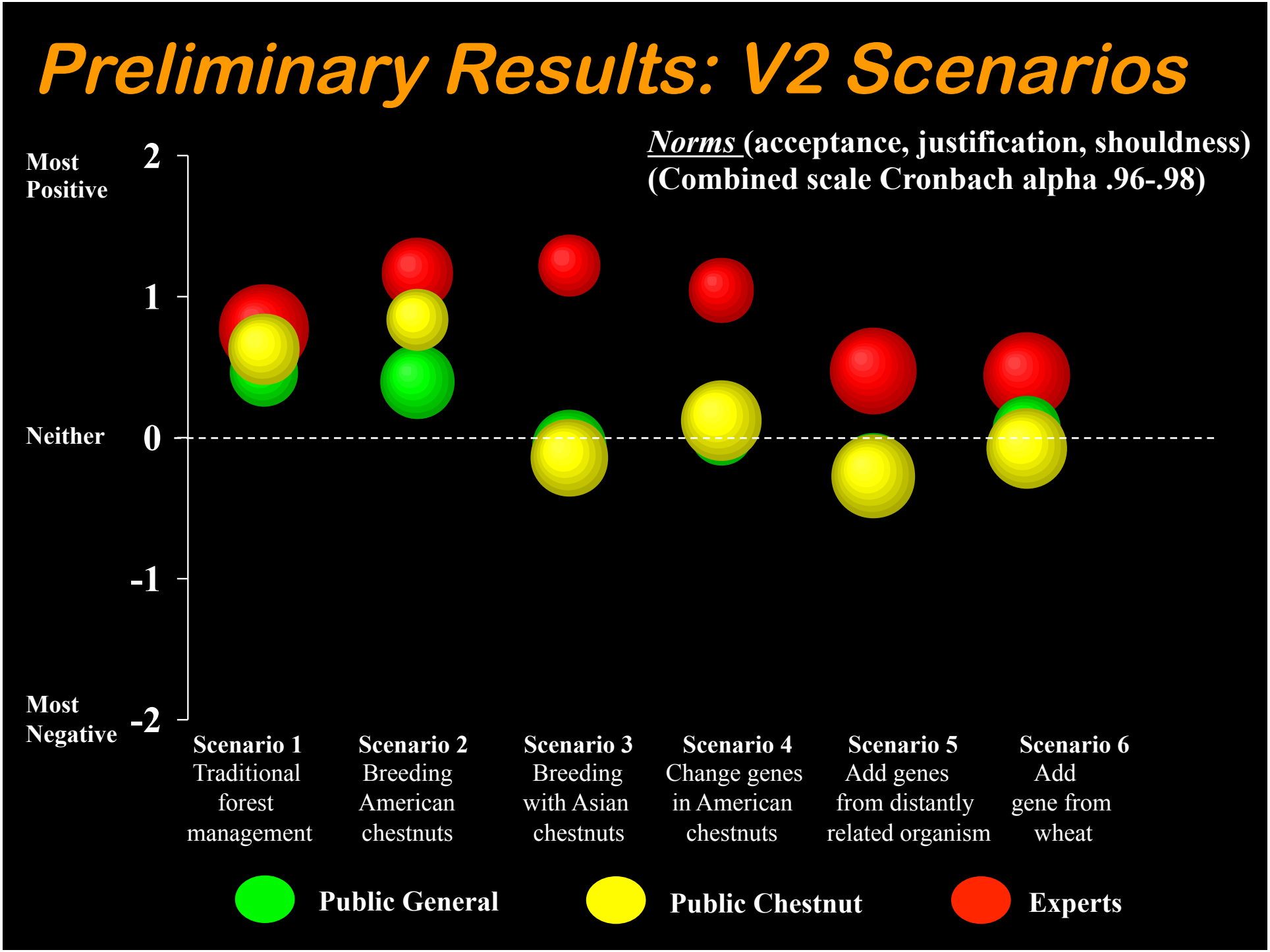


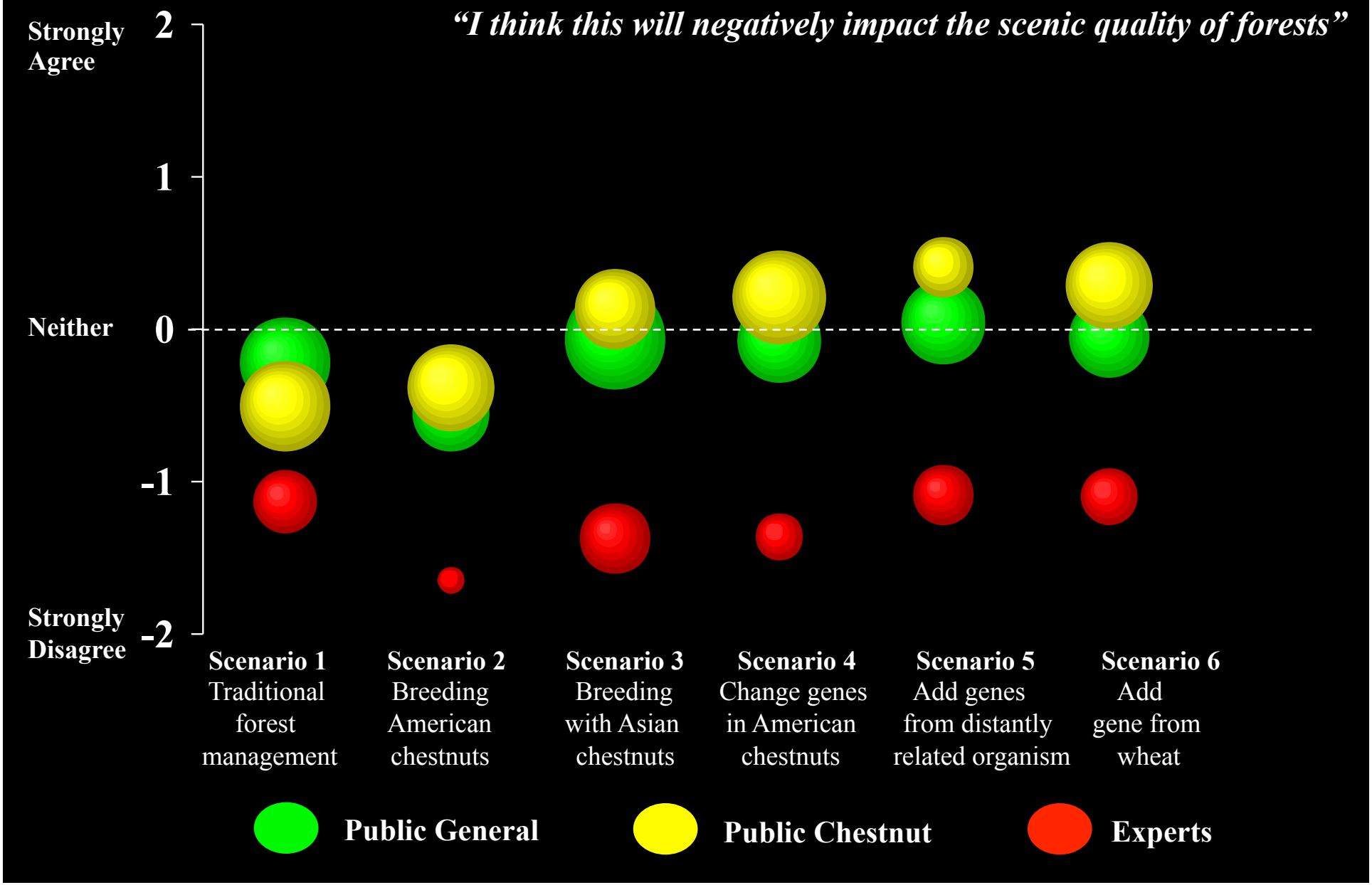
Preliminary Results: V2 Scenarios

Behavioral Intention (single item)

"If you were given an opportunity to vote for or against the scenario, how would you vote?"

	Percent (%) vote "For" (i.e., in favor)					
To help trees resist chestnut blight…	Public General	Public Chestnut	Experts	Total	χ^2 value	Cramer's *V*
Breeding American chestnut trees	77	76	85	80	1.77	.10
Traditional forest management	68	73	73	72	0.45	.05
Change genes in American chestnut trees	58	57	84	69	15.98***	.29
Add gene from wheat	55	54	70	61	4.49	.16
Breeding American chestnut with chestnuts from Asia	43	46	82	60	27.18***	.37
Add genes from distantly related organism	40	44	67	53	11.20**	.25

Preliminary Results: V2 Scenarios



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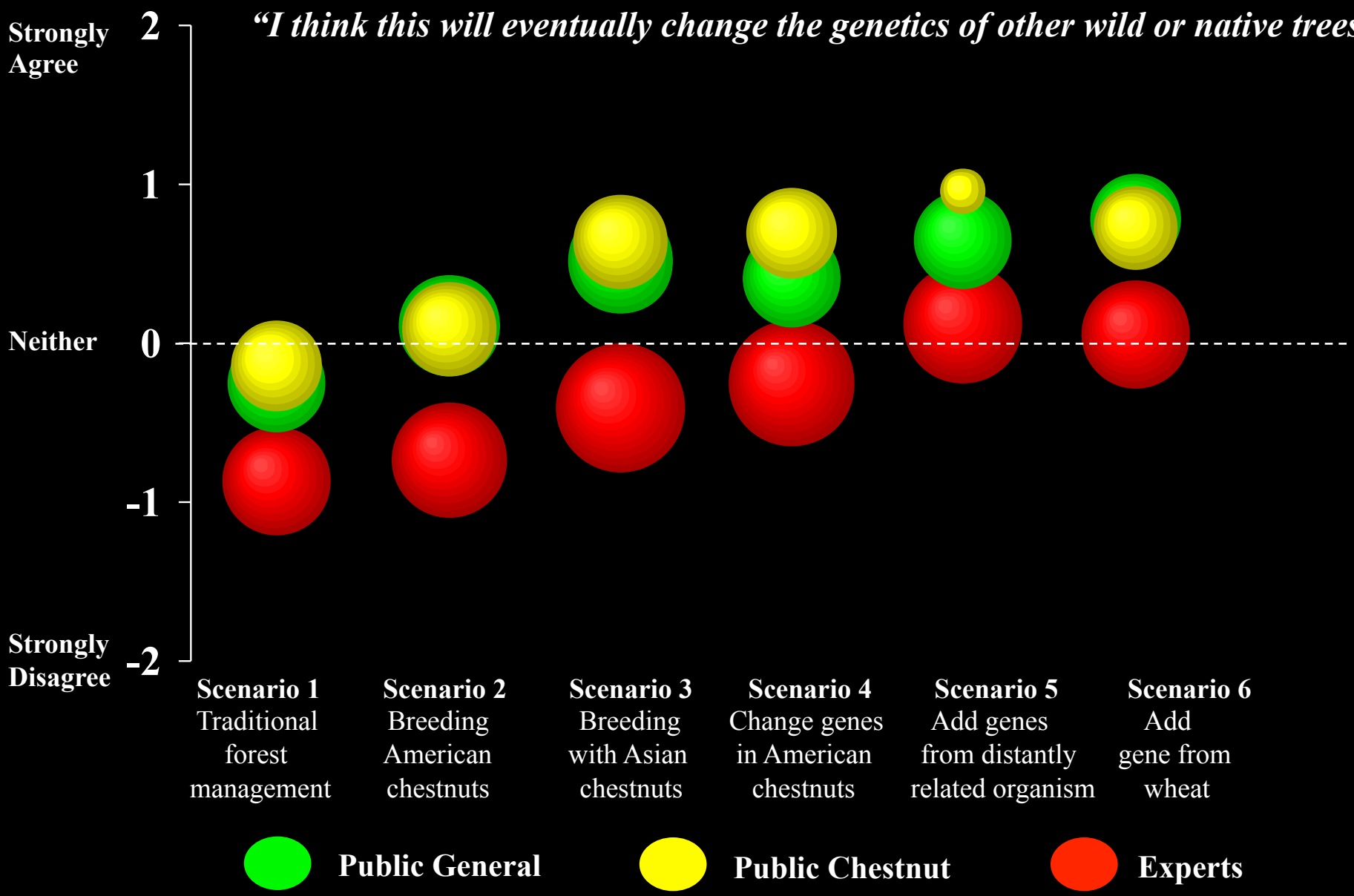

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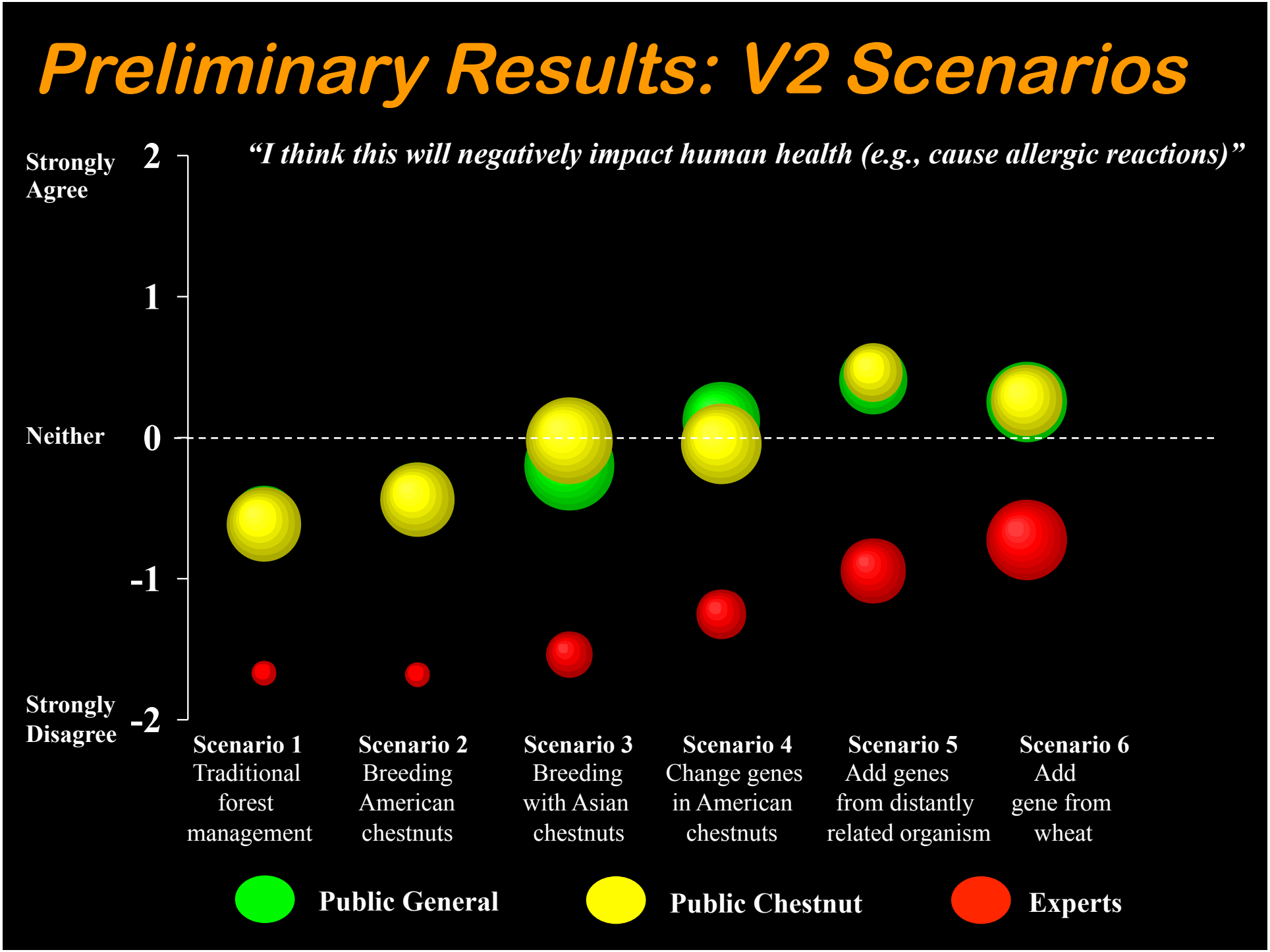

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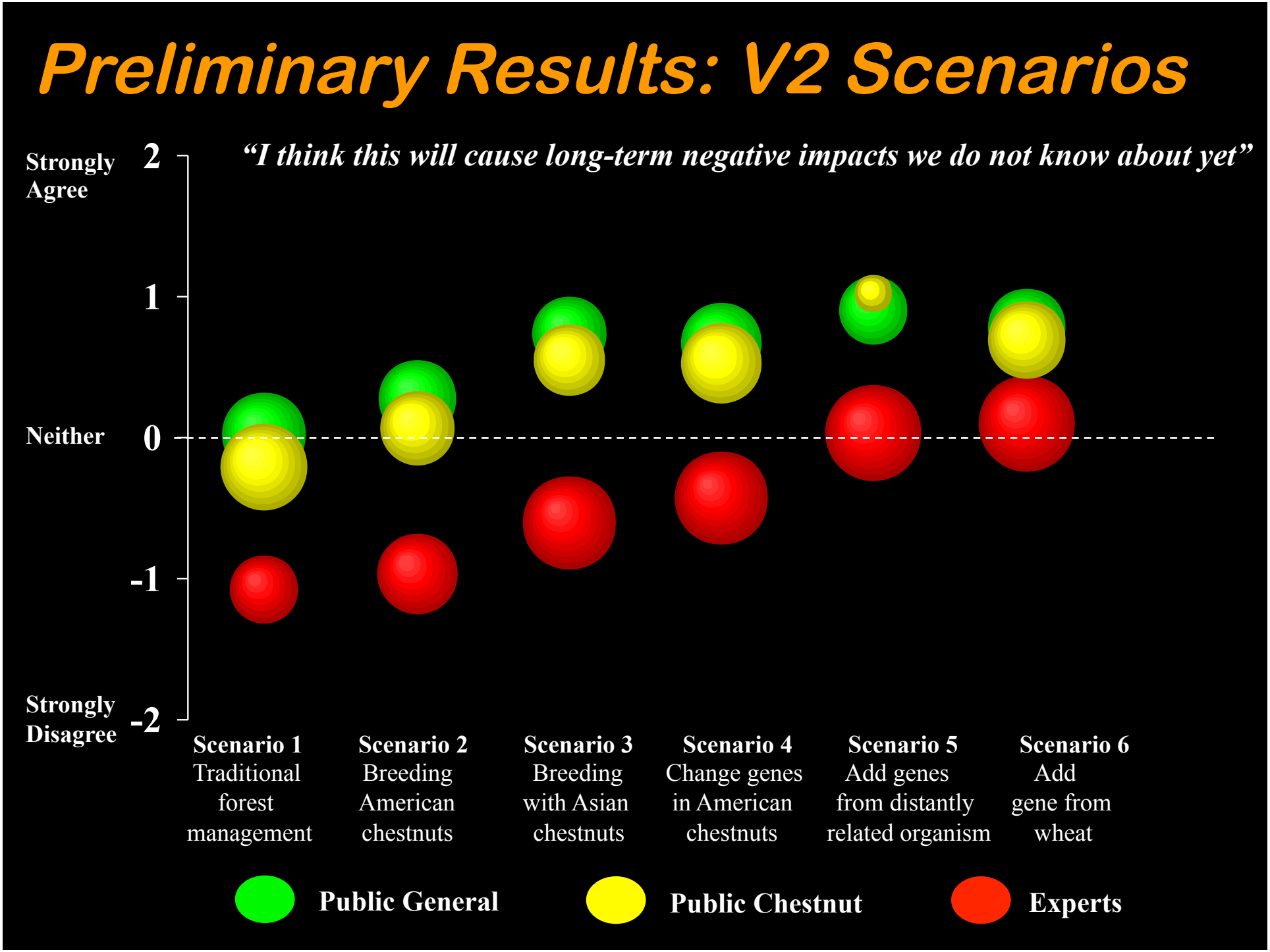

Results vs. Hypotheses

- **Support for interventions is higher for specific & tangible threats (e.g., chestnut blight) than general & less tangible threats (e.g., climate change)**

  …Yes, greater support for genetic modification to address chestnut blight than climate change and forest growth, but support for tree breeding & traditional forest management is less dependent on threat...

- **Support for intervention methods varies, with lowest for genetic modification from distantly related species**

  …Yes, greatest support for traditional forest management & within-species breeding, & lowest for genetic modification from distantly related species & breeding with Asian chestnuts (between-species)…

Results vs. Hypotheses

- **Support for interventions, especially genetic modification, is influenced by drivers such as environmental values, perceptions of risk, & demographic characteristics**

  …Next step in the analyses once all surveys have finished coming in (fall this year & into next year)…

- **Support for interventions increases when scientific information is provided (e.g., examples, benefits)**

  …Phase III (next slide)…

- **Information framing using pejorative vs. positive terms influences support (e.g., irreversible release, biodiverse)**

  …Phase III (next slide)…

Next Steps: Phase III

- Focuses on the extent that:
  - Information & education influences public support of biotechnologies to address forest health threats
  - Framing using pejorative vs. positive terminology influences these attitudes
- Experimental design with 2 parts: Part 1 measures initial attitudes toward biotechnologies & Part 2 is 3 weeks later to the same people, but 2 versions:
  - Treatment group: information treatments (pro vs. anti arguments; pejorative vs. positive terminology)
  - Control: no information (attitudes should not change)
- Different survey & smaller sample due to multiple contacts in experimental design (public & students): *n* = 100 in treatment group & 100 in control group
- Between now & project end date (December 2016)

Next Steps

- Finish analyses for Phase II general survey
- Design & complete Phase III experiment
- Final reports & presentations
- Journal articles, conference presentations, PhD dissertation
- Non-technical outreach report to participants who provided email addresses
- Short “best practice” guide for communicating & messaging (based mostly on Phase III)
- Work with cooperatives & extension in outreach

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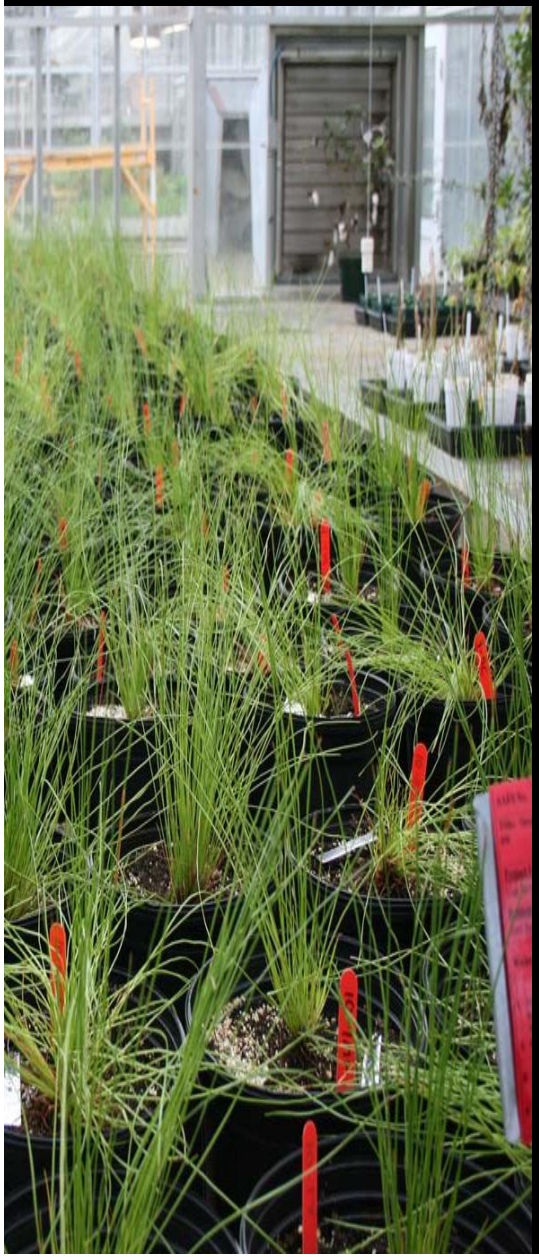
How Could Results Be Used?

- **Design effective education materials & programs**
  - *What cognitions are the "drivers" & should be targeted?*
  - *What information is important or lacking?*
- **Use audience-appropriate language**
  - *Public vs. experts*
  - *Websites*
  - *Interviews (television, radio)*
  - *Newspaper articles*
  - *Scientific literature*
- **Predict public responses to proposed solutions**
  - *Allocate time & resources to realistic options*
  - *Design operationally effective research programs*
  - *Design operationally effective management programs*
- **Guide future social & physical science research**

Additional Work Pending Funding



- Extend to other pests & diseases (e.g., mountain pine beetle, emerald ash borer) for comparison
- Extend to other interventions for comparison (e.g., assisted migration)
- Empirically compare tradeoffs between cognitions linked to food versus forest genetic interventions (plan to do some of this in Phase III experiment)
- Measure any change in cognitions over time (i.e., longitudinal or panel design studies)
- Comparisons to similar issues in other countries
- Much larger / representative experiment (Phase III) to measure effects of framing & messaging