CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

Findings from the Microplastics in Drinking Water Workgroup

Health Effects Report-Out Webinar
September 8th, 2021

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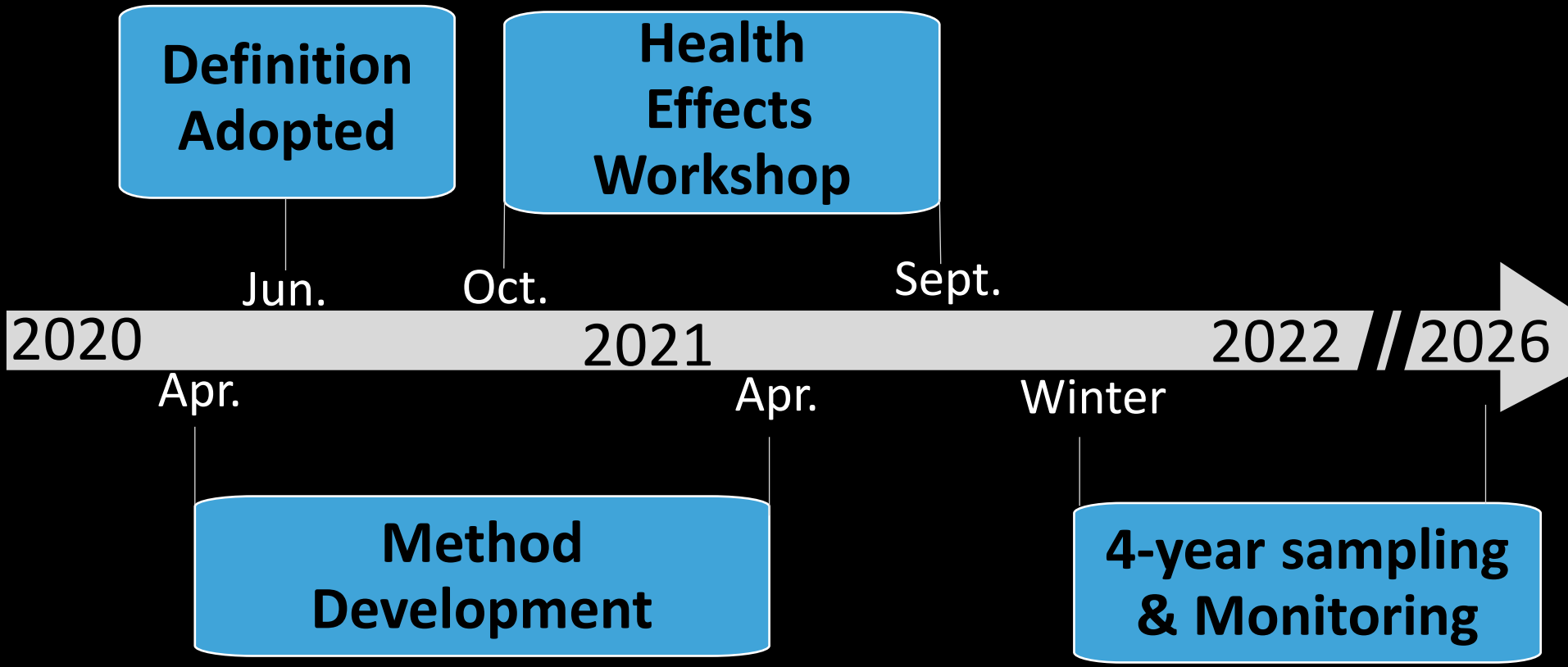
Photo: Getty

Senate Bill 1422 Implementation



Dates subject to change

Two Goals of Workgroup:

1. Develop **framework** for health-based guidance level
   - How many values?
   - For what purposes?

2. Develop appropriate health-based **guidance level(s)**

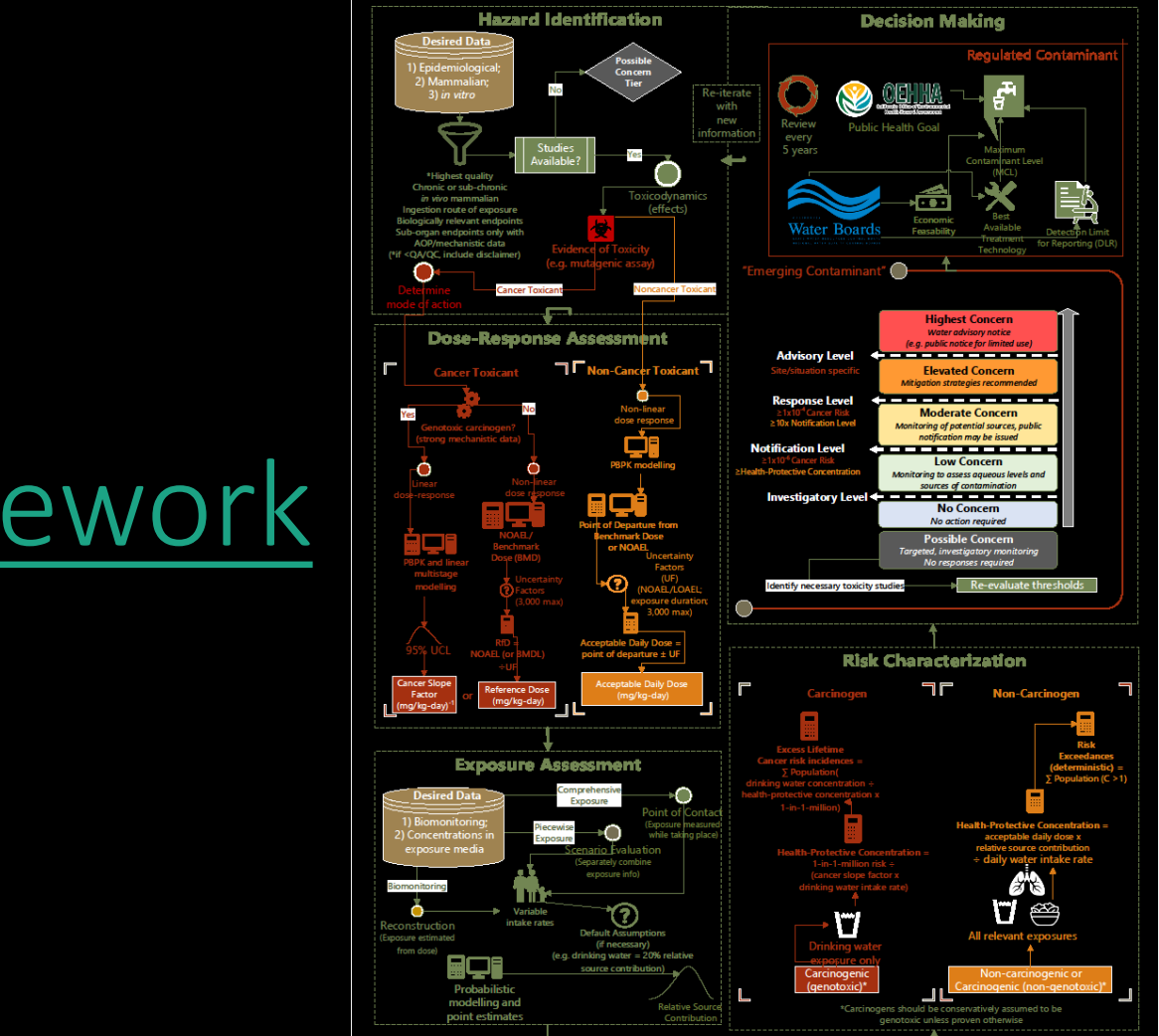
Goal #1:
Develop **framework** for developing health-based guidance level(s)

Success!

Goal #2: Develop Health-Based Guidance Level (if appropriate)

Quality of data did not allow us to develop guidance level for *regulatory purposes,* however we were able to determine appropriate sampling volume and make recommendations for more studies

Goal 1:
Develop Framework



Emerging Contaminant Health-Based Guidance Levels

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Highest Concern
Water advisory notice
(e.g. public notice for limited use)

Advisory Level
Site/situation specific

Elevated Concern
Mitigation strategies recommended

Response Level
≥$1x10^{-4}$ Cancer Risk
≥10x Notification Level

Moderate Concern
Monitoring of potential sources, public notification may be issued

Notification Level
≥$1x10^{-6}$ Cancer Risk
≥Health-Protective Concentration

Low Concern
Monitoring to assess aqueous levels and sources of contamination

Investigatory Level

No Concern
No action required

Possible Concern
Targeted, investigatory monitoring
No responses required

Identify necessary toxicity studies → Re-evaluate thresholds

Goal 2:
Develop Health-Based Guidance Levels (if appropriate)

Three classes of problems

1. Effects database inadequate
    - generally poor particle characterization
    - often too few doses
    - limited polymers, shapes, sizes tested
    - few endpoints tested
2. Effect Mechanisms Unknown
    - necessary for extrapolation to diverse particle types
3. Incomplete exposure data
    - limited information on food, inhalation
    - *no information* on California drinking water

Values we DID derive

1. Recommended concentrations for toxicity studies
    - experiments done at very high concentrations
    - sensitive lower concentrations identified

2. Water volume for monitoring
    - vital for exposure characterization in drinking water
    - Too much = expensive
    - Too little = miss critical concentrations

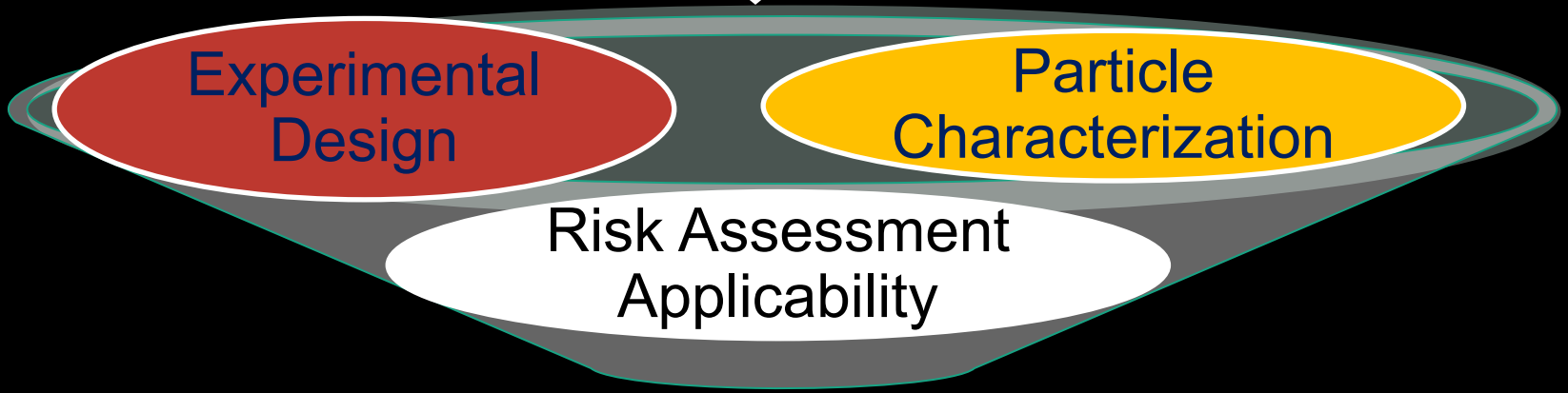
Framework

1. **Hazard Identification**
   a. Screening & prioritization
   b. Identify effects
2. **Dose-response Assessment**
   a. Benchmark dose modelling
   b. Physiological based particokinetic modelling
   c. Uncertainty adjustment
3. **Exposure Characterization**
   a. Biomonitoring
   b. Concentrations in exposure media
4. **Risk Characterization**
   a. Data alignment

- Completed
- High uncertainties
- Missing Data

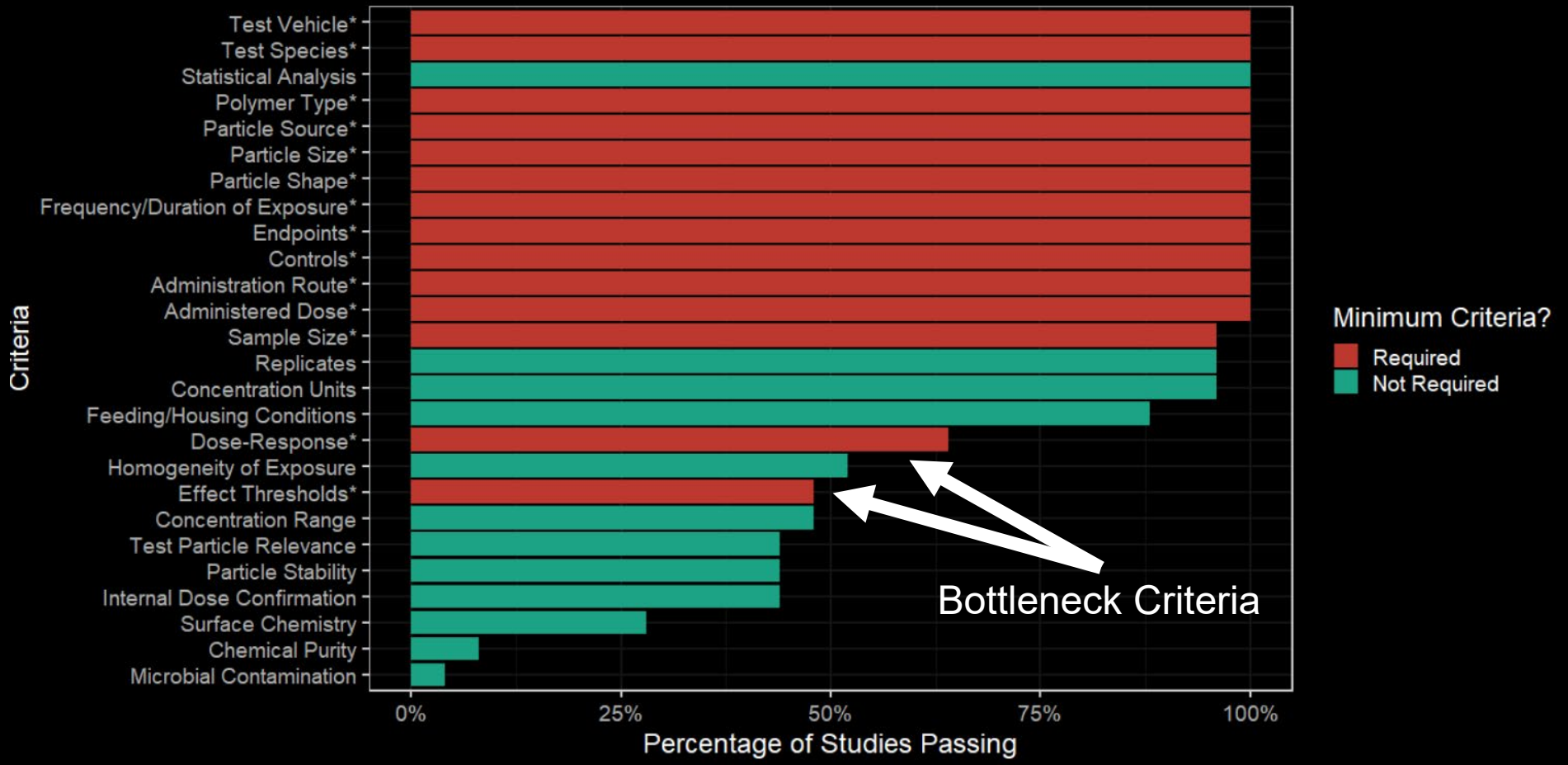
Screening and Prioritization Results

Relevant Microplastics Hazard Studies
(**n = 29**)

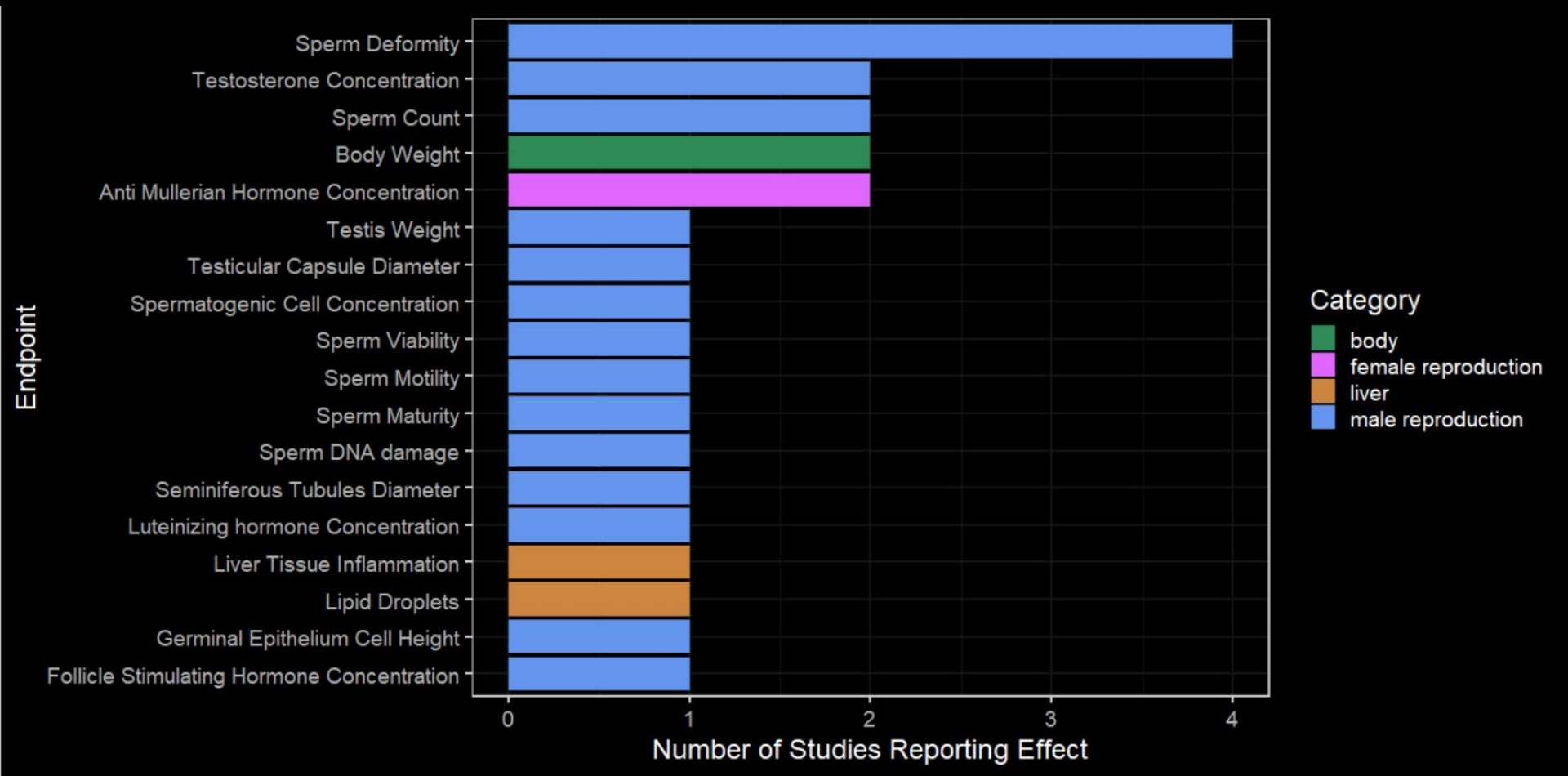


Fit for purpose studies
(**n = 12**)

Screening and Prioritization Results



Endpoints Deemed Reliable by Experts



Effect Mechanisms Poorly Understood

Some Commonly observed mechanisms

- Reactive oxygen species
- Oxidative stress
- Inflammation
- Cell death
- Lipid metabolism
- Energy metabolism

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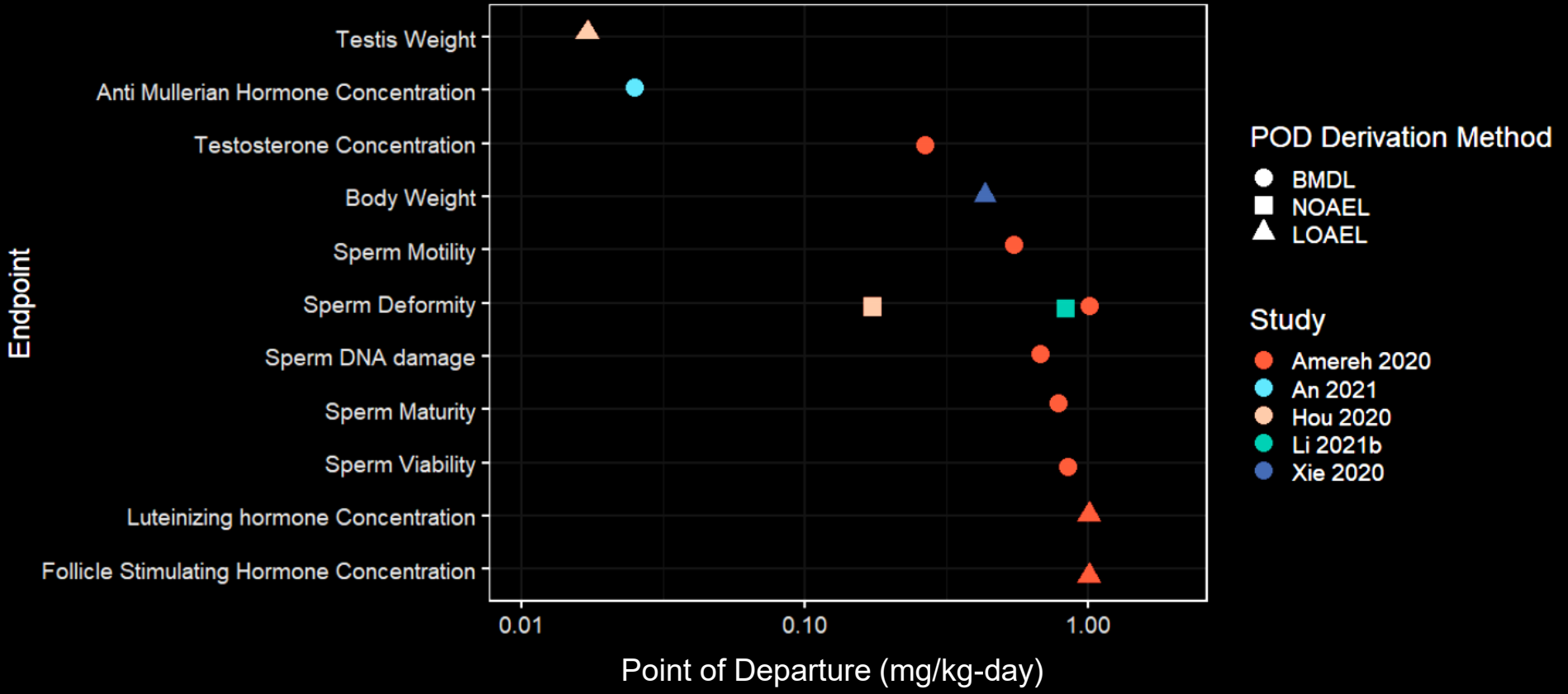
Dose-Response Assessment Results



Rodent to Human Uncertainty Adjustments

$$Reference\ Dose\ (\frac{mg}{kg-day}) = \frac{Point\ of\ departure(\frac{mg}{kg-day})}{Uncertainty\ Adjustments\ (3{,}000)}$$

Critical effect based on male reproductive toxicity

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Incomplete Assessment of Concentrations in Exposure Media

- Limited food and inhalation data
- Non-standardized methods used for existing data
- No California-specific data

Default assumption:

20% contribution from drinking water

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Non-Regulatory Screening Level Derivation

Non-regulatory Reference Dose:
1.7 ng/kg-day*

Relative source contribution (RSC) from drinking water:
20%

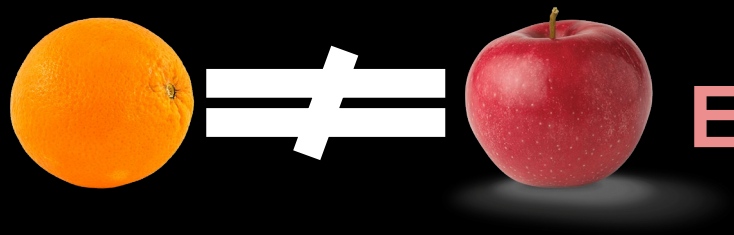
California drinking water intake (DWI):
0.053 L/kg-day (70-yr lifetime weighted average)

***Non-regulatory* Drinking Water Screening Level:**
6.4 ng/L*

***based on 5 μm PS spheres**

Relating Effects Studies to Exposures

Environmental Microplastics



Effect Studies

Aligned data using methods in Kooi et al (2021), *Water Research*

Aligned Drinking Water Screening Levels

		TRM Alignments (1 – 5,000 µm)			
size (um)	*Unaligned* mass Concentration (ng/L)	Mass (particles/L)	Surface Area (particles/L)	Volume (particles/L)	Specific Surface Area (particles/L)
5	6.4	318	257	686	1.2
20	2,550	126,000	25,500	272,000	1.8

Non-regulatory Drinking Water Screening Level

Alignments performed according to Kooi et al (2021), *Water Research*

Method Inter-laboratory Validation Study

Method Limit of Quantification: ~3,000 particles

Drinking Water

FTIR Spectroscopy

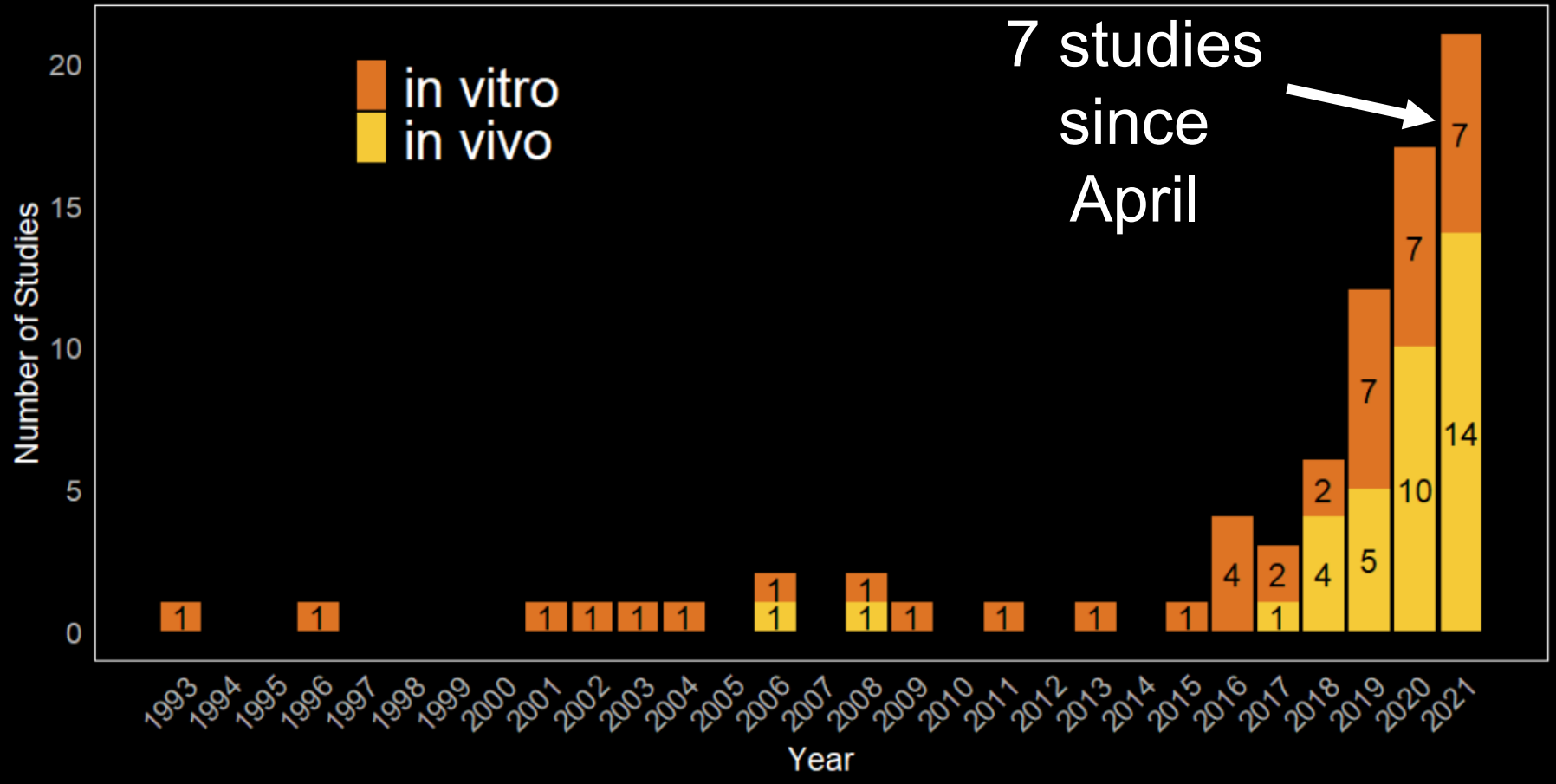
Raman Spectroscopy

Sampling Volume for Monitoring

$$\frac{3{,}000\ particles}{1\ particles/L} = \mathbf{3{,}000\ liters}$$

1,000 liters suggested for drinking water based on representativeness (Koelmans et al, *Water Research* 2019)

Rapidly Changing Science



Recommendations For Hazard Experiments

1. Study diversity of endpoints and organs
2. Use ≥3 exposure concentrations
3. Use realistic exposures (shape, size, polymer)
4. Characterize particles

Recommended concentrations for toxicity studies

Size (um)	Endpoint	Concentration (ug/kg-day)
0.04	Reproduction	100
0.5	Reproduction	25
5	Body Condition	2
5	Reproduction	43
20	Body Condition	675

Conclusions

1. Screening level informs monitoring
2. Values derived not recommended for regulations
3. Funding needed for hazard studies