

**Supplemental Meeting Documents for the Wildlife Resources Committee
September 15, 2022**

Item 5(B)(II): [Chronic wasting disease presentation](#)

Item 10: [**DRAFT** Staff recommendations from the American bullfrog and non-native turtle stakeholder engagement process](#)

California Department of Fish and Wildlife

Chronic Wasting Disease: An Ounce of Prevention...

Presentation to the California Fish and Game Commission,
Wildlife Resources Committee, September 15, 2022

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**NO TIME
TO WASTE**

KEEP CWD AWAY



An ounce of prevention...

- What is chronic wasting disease (CWD).
- Why we should all care about it.
- Recommend updates to current regulations, and why:
 - Update language to clarify hunter import regulations and include moose, caribou, and other susceptible species.
 - Provide clear live cervid possession, importation, and transportation regulations
 - Restrict the use or possession of biological products from cervids like scent lures/attractants.

What is CWD?

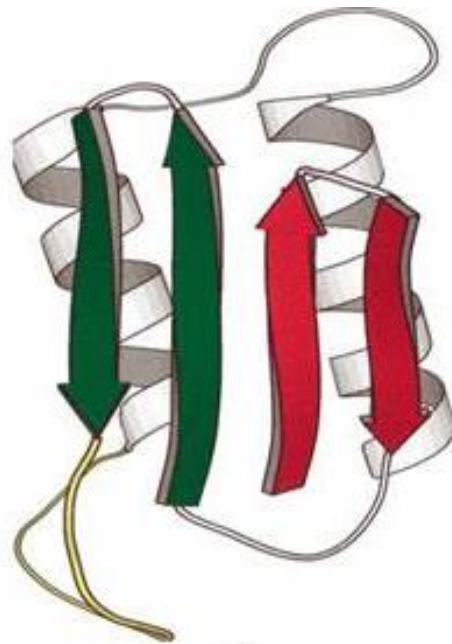
transmissible spongiform encephalopathy (TSE)

PRION = PRotein infectION

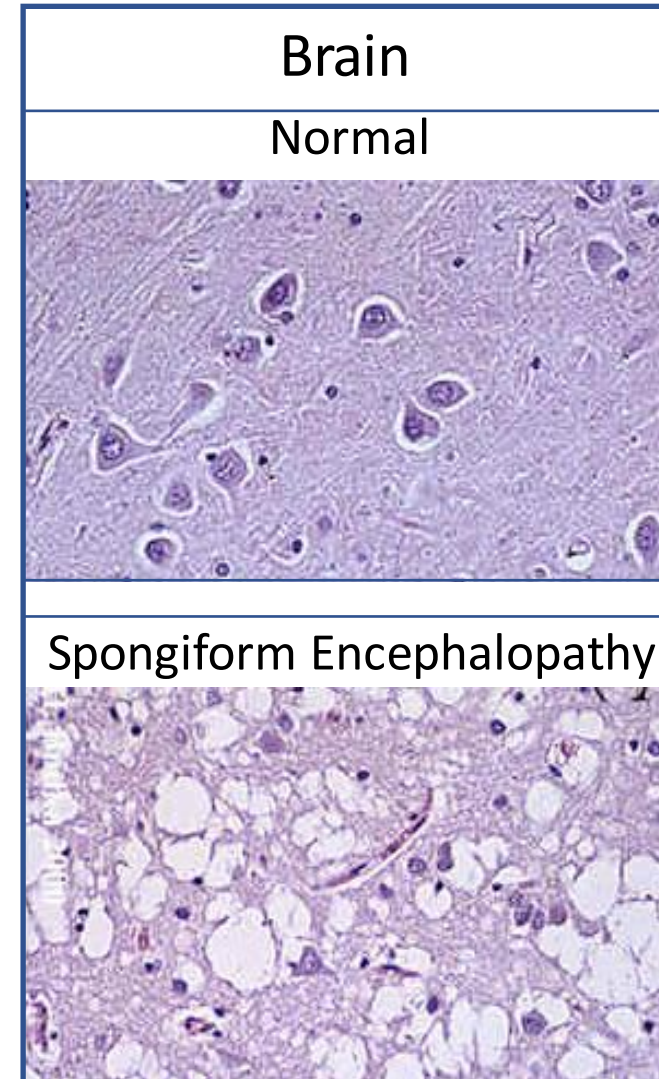
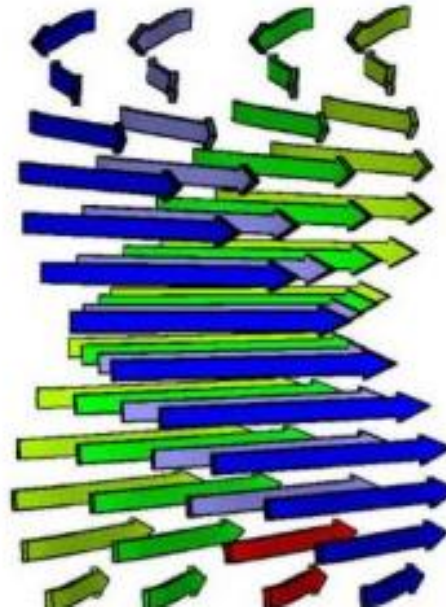
Normal Morphology



Disease-Causing Morphology



Amyloid Formation



Examples of Prion Diseases

Animals

- Scrapie
- Bovine Spongiform Encephalopathy (BSE)
- Chronic Wasting Disease (CWD)
- Camel prion disease

Humans

- Creutzfeldt-Jakob disease (CJD) and variant-CJD
- Kuru
- Fatal familial insomnia



Brain section showing spongiform pathology characteristic of Creutzfeldt-Jakob

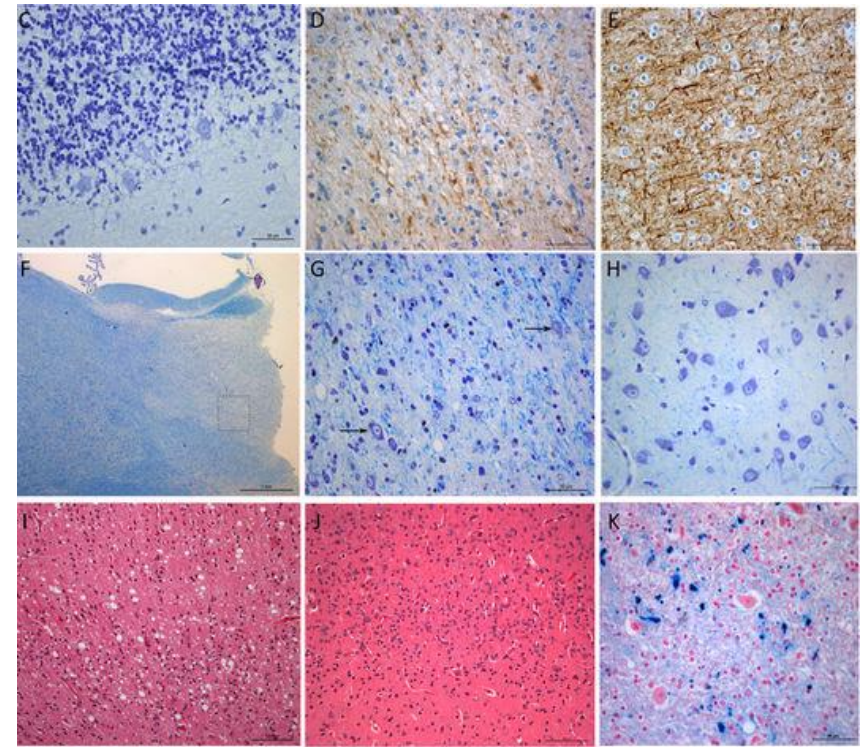
UNKOWN HUMAN RISK

No evidence CWD affects people, however:

- Macaques may be susceptible (Czub et al. 2017)
- WHO, CDC, AFWA recommendation:

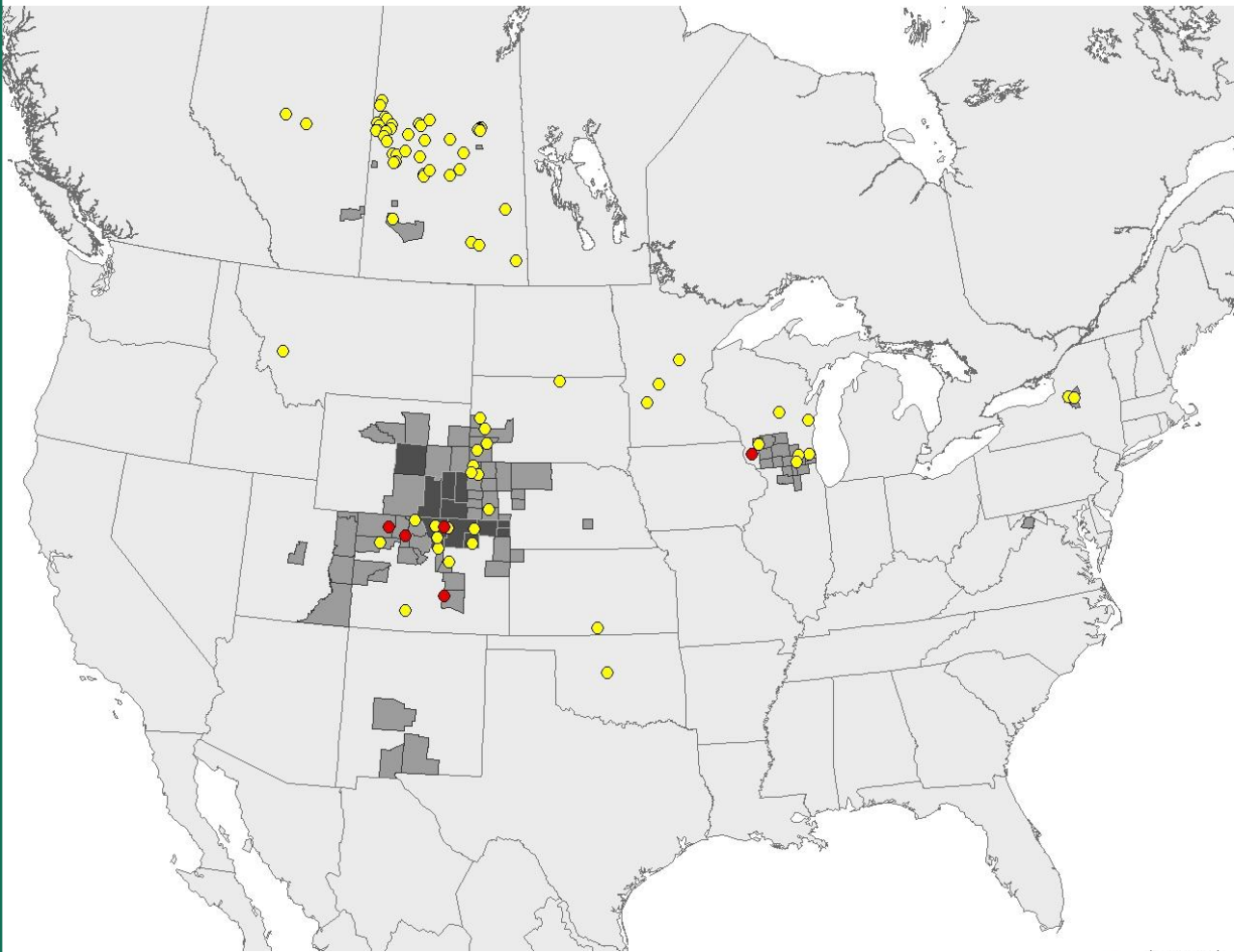
“keep the agents of all known prion diseases from entering the human food chain.”

- States increased hunter outreach, testing, and recommendations

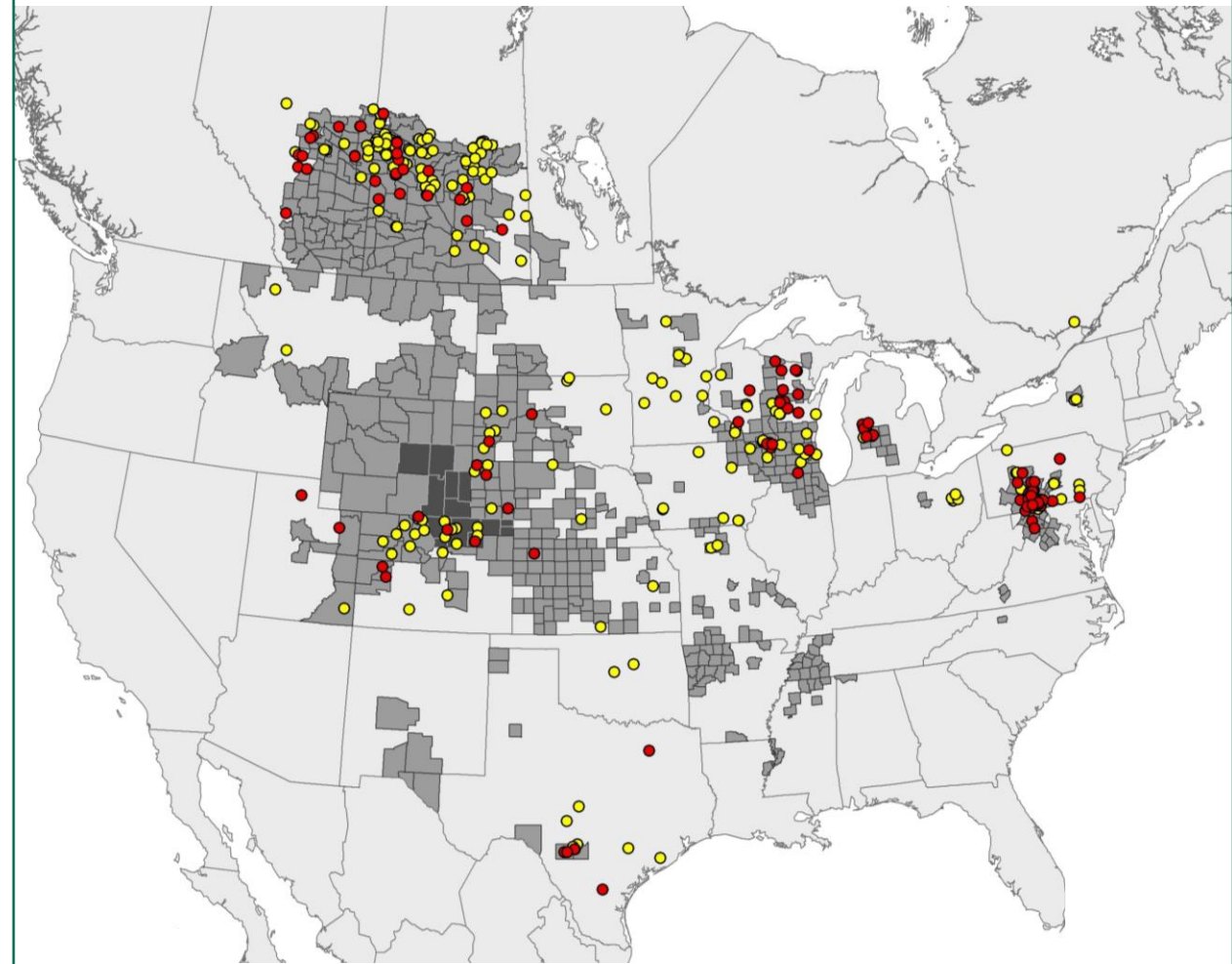


Unabated spread

November 2006



April 2022



Why we care

Mule Deer, SE Wyoming

- 19% annual decline at 40% prevalence (DeVivo et al 2017)

White-tailed Deer, SE Wyoming

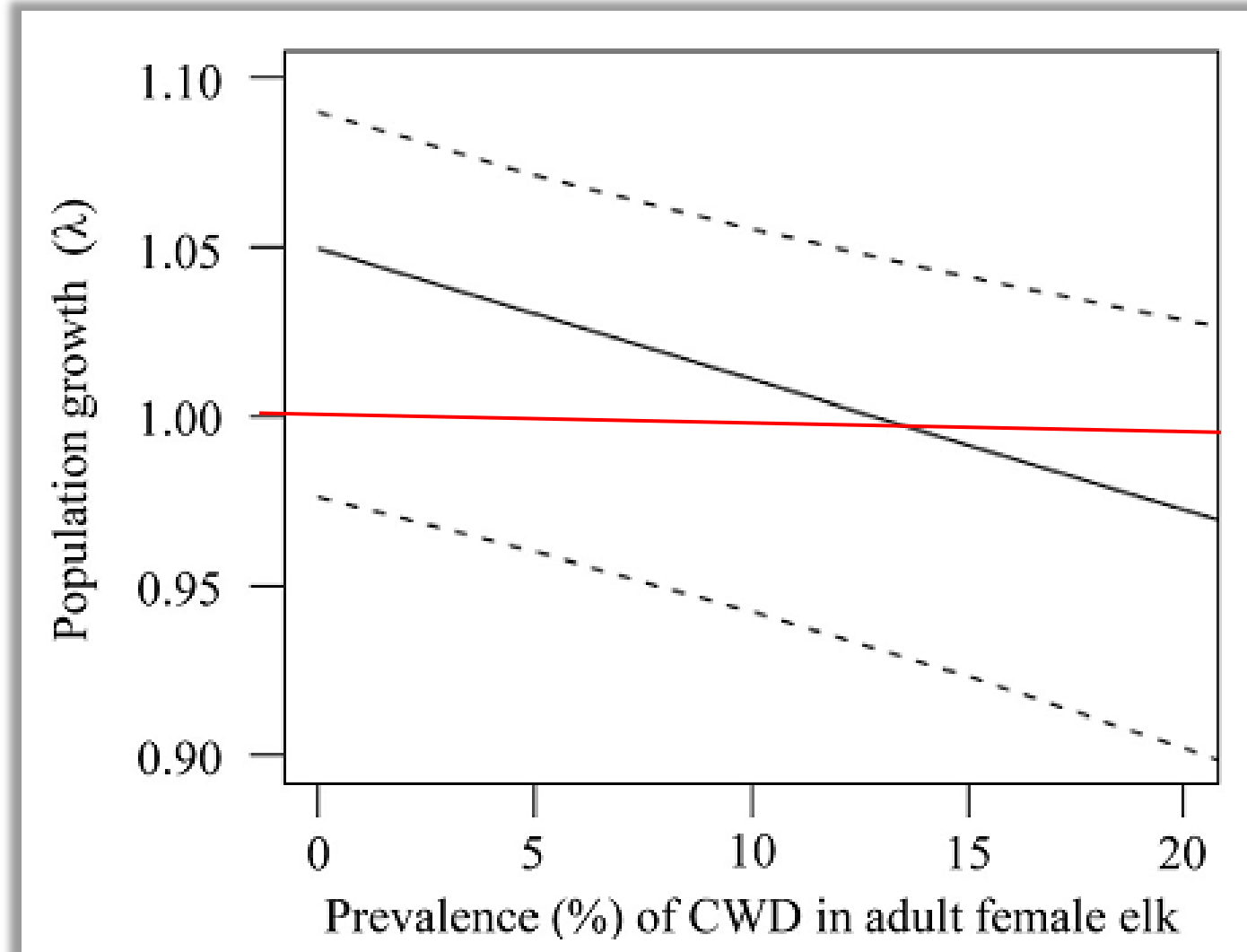
- 10% annual decline at 30% prevalence (Edmonds et al 2016)

Elk, Rocky Mountain N.P, CO.

- Population declines at 13% prevalence (Monello et al 2014)

Mule Deer, Northern CO

- Population effects at 4% prevalence (Geremia et al 2015)



Why we care

CWD IMPACTS

ECONOMIC, HUNTING, HUNTERS

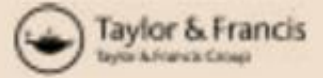
CWD first detected in WI in 2002:

“hunter losses likely amounted to between \$53 million and \$79 million in 2002 and \$45 million to \$72 million in 2003”

CWD risk to people:

Unknown, but likely not zero.

Human Dimensions of Wildlife, 9:181–192, 2004
Copyright © Taylor & Francis Inc.
ISSN: 1087–1209 print / 1533-158X online
DOI: 10.1080/10871200490479963



The Economic Impacts of Chronic Wasting Disease (CWD) in Wisconsin

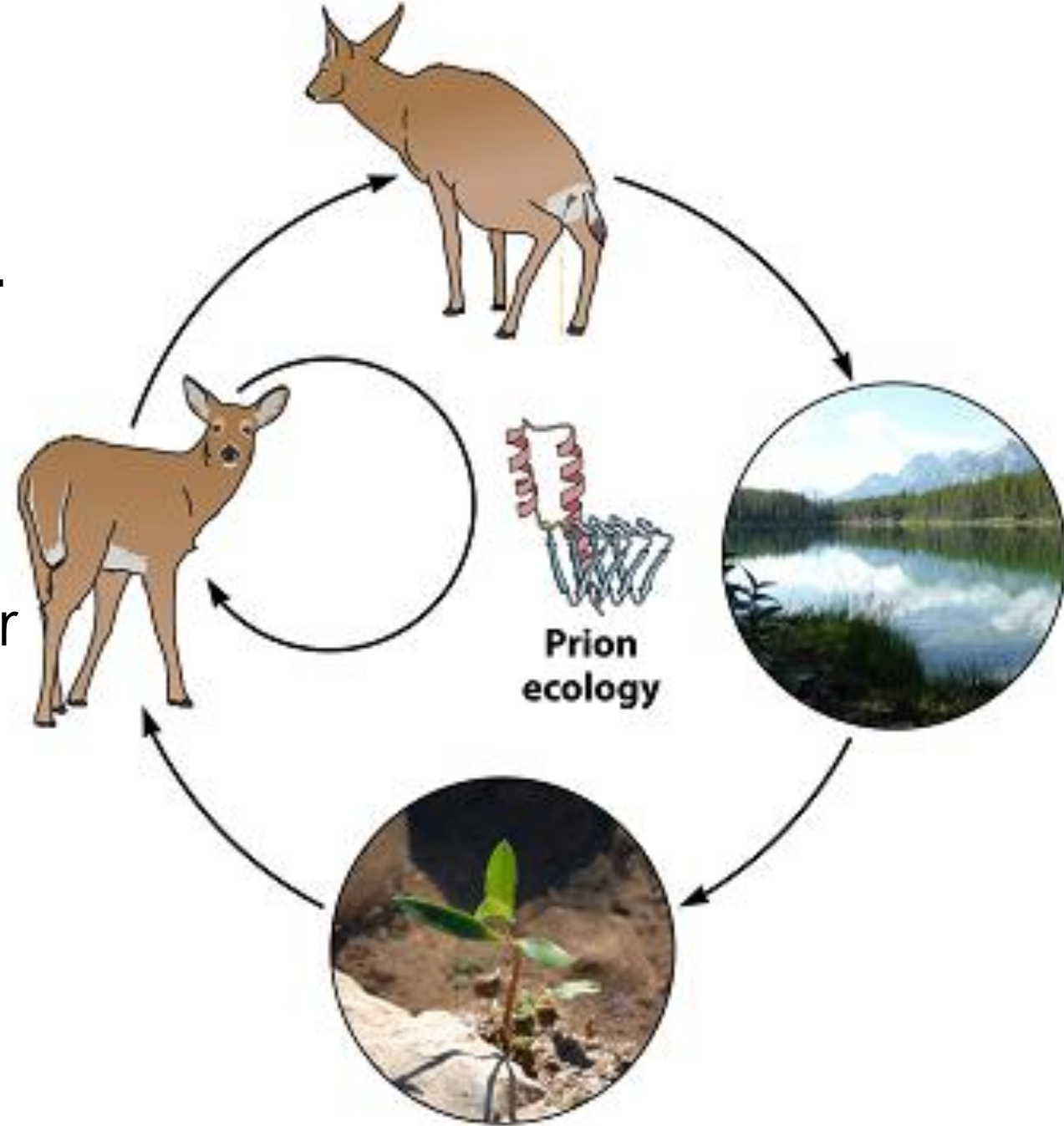
RICHARD C. BISHOP

Department of Agricultural and Applied Economics
University of Wisconsin-Madison



Management Challenges

- Extended Incubation (>15 mos)
- Pre-clinical shedding
- Shed in urine, feces, and saliva
- Infectious in the environment for years
- Environ. Seeding
- No vaccine, despite attempts
- Multiple strains



Why update regulations?

- **TO FURTHER MITIGATE THE LARGEST RISKS FOR IMPORTING CWD into CA:**

The movement of infectious materials from

- **live cervids,**
 - **hunter-harvested cervids, and**
 - **their biological products.**
- **Update existing regulations for the importation (prevention) and movement (spread) of cervids and their parts in California**
 - **Add clarity to existing regulations to remove ambiguities.**

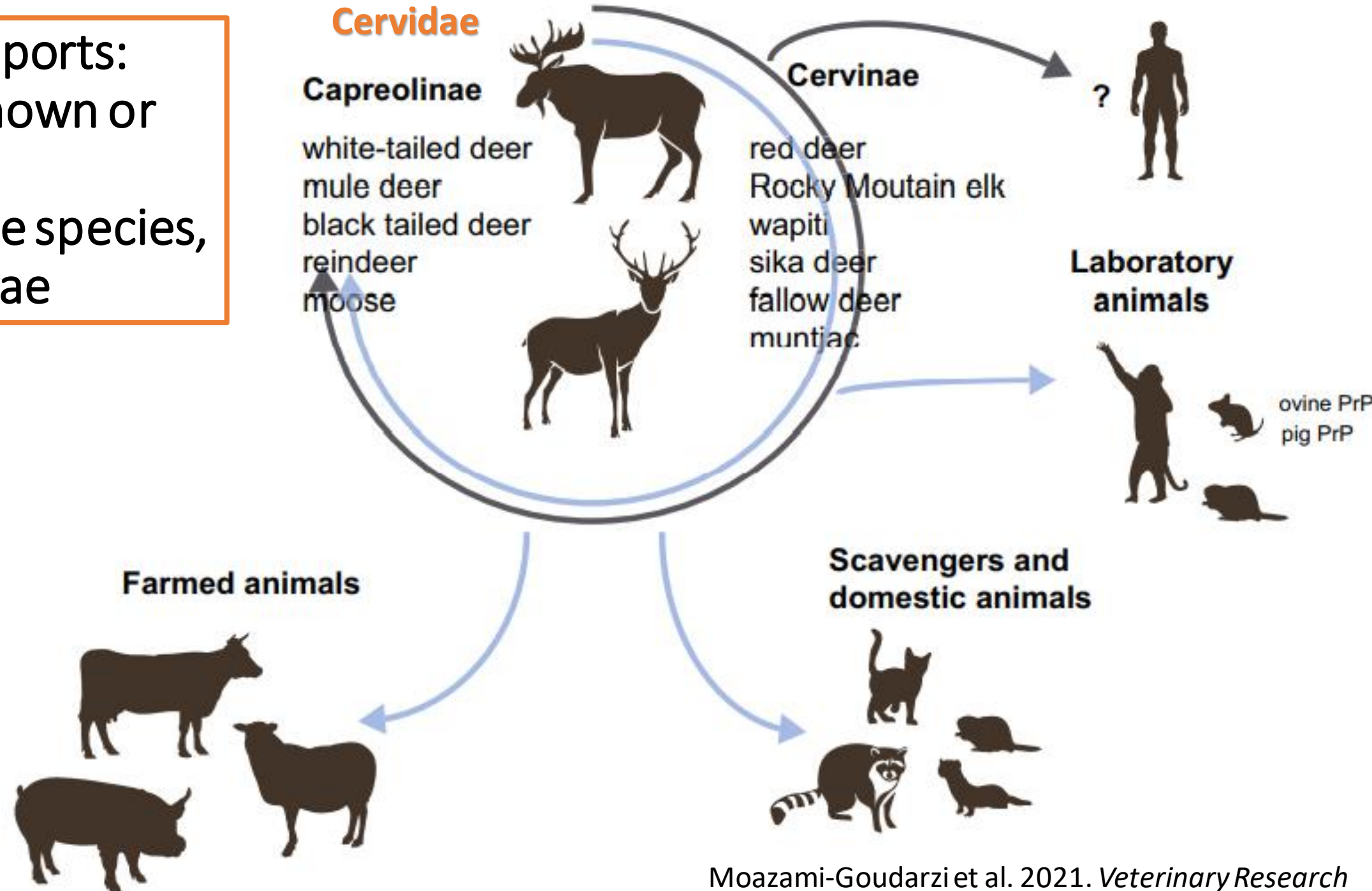
Proposed updates



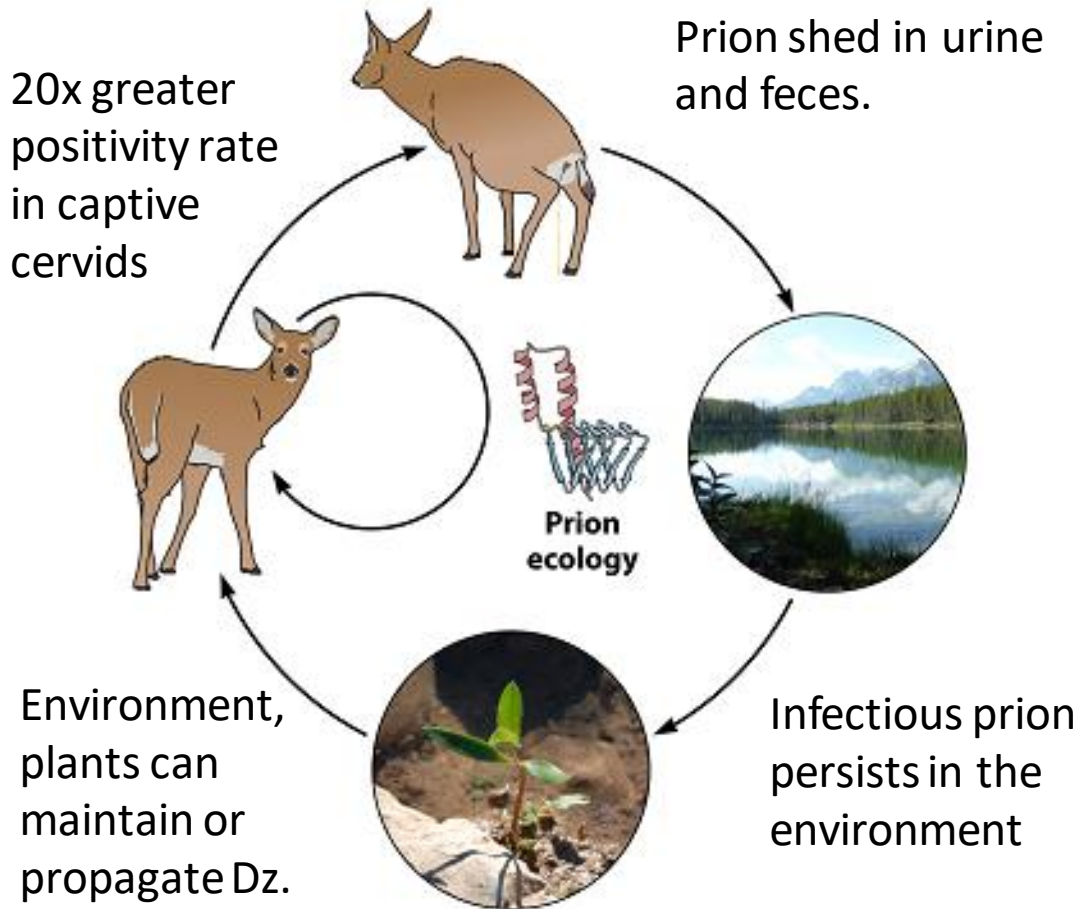
CALIFORNIA CODE OF REGULATIONS:

- Update language in hunter-harvest importation regulations:
 - Clarify that all species in Family Cervidae, e.g. moose, caribou, and reindeer, are provided for in the regulation.
 - Clarify what parts can be imported.
- Clear regulations limiting possession, importation, and transportation of live cervids (Family Cervidae) and their products including biological (e.g. urine-based) attractants or scent lures.

Hunter imports:
Include known or
suspected
susceptible species,
i.e. Cervidae

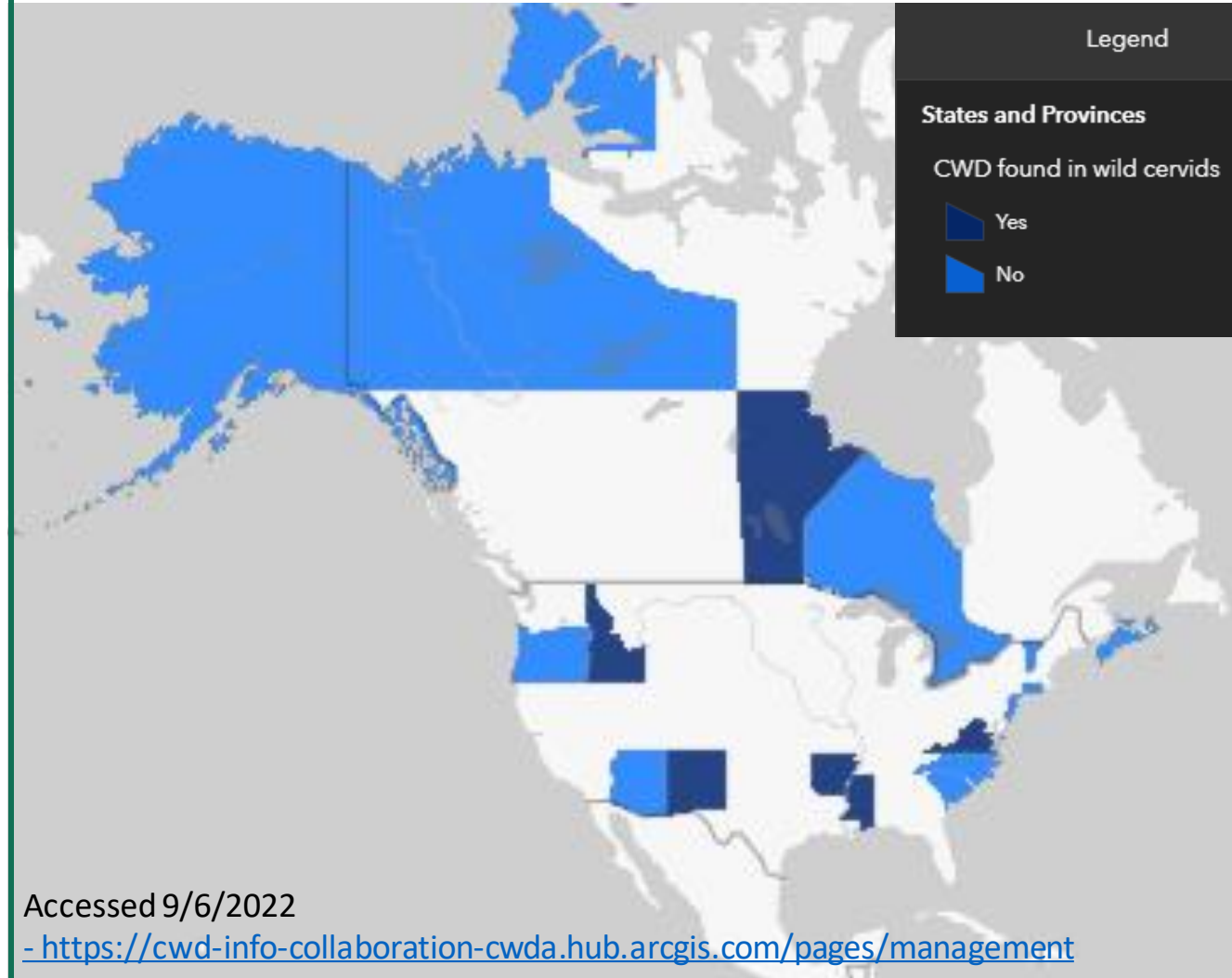


Movement of Live Cervids & Biological products



Zabel and Ortega, 2017. The Ecology of Prions

The 14 States and 6 Provinces that ban urine-based or other biological attractants



Effective alternatives exist





*Photo courtesy of Jason Sumners,
Missouri Department of Conservation*

THANK YOU 😊 QUESTIONS

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For More Information

Where has CWD been Detected: https://cwd-info.org/map-chronic-wasting-disease-in-north-america/	
CWD Related Hunting Regs in North America: https://cwd-info.org/cwd-hunting-regulations-map	
Carcass Transport Regulations across C: https://cwd-info.org/state-and-province-carcass-import-regulations/	

California Fish and Game Commission Wildlife Resources Committee

Draft Staff Recommendations from the American Bullfrog and Non-Native Turtle Stakeholder Engagement Process

September 13, 2022

This document was prepared by California Fish and Game Commission (Commission) staff using the materials from both *Preliminary Results from the Conservation Standards Work in the Bullfrog and Non-Native Turtle Stakeholder Engagement Process* (dated January 7, 2022), which was provided to the Wildlife Resources Committee (WRC) at its January 2022 meeting, and *Draft Staff Analysis of the Conservation Standards Work in the Bullfrog and Non-Native Turtle Stakeholder Engagement Process* (dated May 12, 2022), which was provided to WRC at its May 2022 meeting. This document therefore relies on, and is intended to be used in conjunction with, the January and May documents.

Contained in this document are the various strategies proposed by the three stakeholder groups participating in the Commission’s engagement process. Some strategies are relatively independent, while others are more dependent on, or synergistic with, other strategies. In addition to considering strategies one-by-one, this analysis provides a representative sampling of strategy combinations (“bundles”). Not all viable permutations are represented, and WRC may recommend strategy bundles that are not considered here.

Strategies

The three stakeholder groups identified 34 strategies that potentially could be used in California for addressing American bullfrog and non-native turtle concerns. For each strategy, effectiveness ranks are low efficacy, potentially effective, effective, and very effective; see the *Draft Staff Analysis of the Conservation Standards Work in the Bullfrog and Non-Native Turtle Stakeholder Engagement Process* for an explanation of how this value was calculated. Level of controversy is an estimate of opposition/acceptance from all stakeholders. Key actors represents an assessment of the various sectors of society which would potentially be involved in implementing the strategy – some of these actors are critical while others may be optional. Question marks indicate uncertainty about whether a key actor’s involvement would be important to implement the strategy.

Key: DFW = California Department of Fish and Wildlife; Leg = California State Legislature; Fed = Federal partners; Public = Various stakeholder groups and organizations; Localities = Local municipalities, water agencies, and/or counties; Private = Private landowners

Strategy	Effectiveness	Level of Controversy	Key Actors
1. More resources for DFW	Effective	Low	Leg, DFW
2. Raise permit prices	Potentially Effective	Medium	DFW, Commission?
3. DFW grant program	Potentially Effective	Low	DFW, Leg

Strategy	Effectiveness	Level of Controversy	Key Actors
4. Research into release “inputs”	Very Effective	Low	DFW, Fed
5. Research on discharge	Potentially Effective	Low	DFW, Fed
6. Research into live food as vectors for disease	Very Effective	Low	DFW, Fed
7. Research into population control techniques	Potentially Effective	Low	DFW, Fed
8. Encourage wild collection	Potentially Effective	Low	DFW, Commission?
9. Bullfrogs as bait	Low Efficacy	Low	DFW
10. Education campaign 1 (Live markets)	Potentially Effective	Low	DFW, Public
11. Education campaign 2 (Pets)	Effective	Low	DFW, Public
12. Education campaign 3 (All-Encompassing)	Very Effective	Low	DFW, Public
13. Increased compliance with animal release regulations	Potentially Effective	Low	DFW
14. Habitat improvement	Potentially Effective	Low	DFW, Fed
15. Localized eradication	Effective	Low	DFW, Fed
16. Use of private land eradication of fish	Effective	Low	Leg?, Commission, DFW, Private
17. Ban sale of live bullfrogs	Effective	High	Commission
18. Point of sale inspections	Potentially Effective	Medium	DFW
19. Domestic bullfrog aquaculture	Potentially Effective	Low	Commission, DFW
20. Testing and monitoring regime	Potentially Effective	High	DFW
21. Increase information collection through permits	Low Efficacy	Low	DFW, Commission

Strategy	Effectiveness	Level of Controversy	Key Actors
22. Promotion of programs for unwanted animals	Low Efficacy	Low	DFW, Public
23. Dispatching bullfrogs in contests	Effective	High	FGC, DFW
24. Ban frog jumping contests	Low Efficacy	High	Leg, Commission?
25. Contest monitoring/enforcement	Potentially Effective	Medium	DFW
26. Encourage/Allow use of other species with lesser effects	Potentially Effective	High	Commission
27. Water & reservoir management	Potentially Effective	Medium	DFW, Localities, Private
28. Ban bullfrog imports	Effective	High	Commission
29. Develop commercial harvesting	Potentially Effective	Medium	Commission, DFW
30. Add non-native turtles to restricted species list	Low Efficacy	High	Commission
31. Add bullfrogs to restricted species list	Low Efficacy	High	Commission
32. Prevent water contamination	Potentially Effective	Low	Commission
33. Ensure shipments are lawfully obtained	Potentially Effective	Low	DFW
34. Inspect shipments for illegal imports/mixing species	Potentially Effective	Low	DFW

Options and Recommendations

Draft recommendations are ranked on a scale of 1 to 5, with 1 meaning “not recommended,” 2 is “probably not recommended,” 3 is “recommended if willing to accept some drawbacks and/or disadvantages,” 4 is “this is recommended,” and 5 is “highly recommended.” Note that recommendation ranks for individual strategies refer to implementation of the single strategy. Recommendations for strategies may change when combined with other strategies (see **Strategy Bundles**).

Individual Strategies

Strategy 1: More Resources for DFW

Procure more budgetary resources for DFW, either directly from the California State Legislature or through a special program, such as voluntary income tax contributions.

Strategy	Effectiveness	Level of Controversy	Key Actors
More resources for DFW	Effective	Low	Leg, DFW

Recommendation rank: 5

This option is a necessity to implement any strategy which DFW cannot absorb in existing budgets and initiatives. Essentially, any strategy that is not solely regulatory in nature will require additional resources to implement, and even solely regulatory actions can have budget implications for management activities, such as outreach, education and enforcement.

Strategy 3: DFW Grant Program

Establish a new grant program for DFW to disburse funds for various bullfrog and non-native turtle projects.

Strategy	Effectiveness	Level of Controversy	Key Actors
DFW grant program	Potentially Effective	Low	DFW, Leg

Recommendation rank: 5

If a stable funding source for bullfrog and non-native turtle-related grants can be established, it could serve as a springboard for the implementation of innovative projects that could not or would not otherwise be attempted, serve to highlight the subject as an important issue needing attention, answer important research questions, and funnel resources to organizations that may be able to supplement DFW and Commission initiatives.

Strategy 8: Encourage Wild Collection

Promote collection of bullfrogs for personal food use as an alternative to purchase in live markets.

Strategy	Effectiveness	Level of Controversy	Key Actors
Encourage wild collection	Potentially Effective	Low	DFW, Commission?

Recommendation rank: 3

While this strategy would likely have only positive benefits and a campaign would be relatively simple to employ, wild collection of frogs and turtles is unlikely to be popular enough to have much of an effect on wild invasive populations. The ultimate benefit of such a campaign will greatly depend on the resources necessary in order to significantly expand wild collection as a recreational activity.

Strategy 24: Ban Frog Jumping Contests

Frog jumping contests would be outlawed through regulation.

Strategy	Effectiveness	Level of Controversy	Key Actors
Ban frog jumping contests	Low Efficacy	High	Leg, Commission?

Recommendation rank: 1

This strategy would require legislative repeals of current Fish and Game Code sections and would prohibit a popular recreational activity. The true significance of frog jumping contests as a vector for disease is unknown, and this strategy may be too extreme given the actual risk.

Strategy 26: Encourage/Allow Use of Other Species with Lesser Effects

Disallow or discourage the use of bullfrogs in jumping contests, in favor of utilizing other species.

Strategy	Effectiveness	Level of Controversy	Key Actors
Encourage/allow use of other species with lesser effects	Potentially Effective	High	Commission

Recommendation rank: 1

This option could also be implemented as a regulatory mandate rather than simple encouragement, though the legality of such a regulation is yet to be determined. Encouraging the use of native species in jumping contests could have negative effects for those species, such as encouraging aggressive collection of declining or sensitive species and substantially reducing populations in local areas. Contest participants would likely object, since bullfrogs are prized for their jumping prowess.

Strategy 9: Bullfrogs as Bait

Promote the use of bullfrogs as bait for fishing.

Strategy	Effectiveness	Level of Controversy	Key Actors
Bullfrogs as bait	Low Efficacy	Low	DFW

Recommendation rank: 2

This strategy is easy to implement, but likely to have very limited impact. Angler reception to using bullfrogs is unknown, and bullfrog bait may be of limited use to anglers.

Strategy 13: Increased Compliance with Animal Release Regulations

Education initiative aimed primarily at reducing intentional releases, including live market, unwanted pets, and other wildlife releases. One potential audience is local and county officials, to encourage the development of local ordinances which may play a role in reinforcing state regulations against releases as well.

Strategy	Effectiveness	Level of Controversy	Key Actors
Increased compliance with animal release regulations	Potentially Effective	Low	DFW

Recommendation rank: 3

Requires the cooperation of local municipalities to enact and enforce ordinances. As most animal releases happen in secret, enforcement is likely impossible to administer.

Strategy 14: Habitat Improvement

Implement restoration projects to improve conditions for various native species to allow them to better deal with the threats posed by bullfrogs and non-native turtles.

Strategy	Effectiveness	Level of Controversy	Key Actors
Habitat improvement	Potentially Effective	Low	DFW

Recommendation rank: 4

Restoration initiatives are already part of DFW's activities and priorities. The degree to which ongoing activities could account for bullfrogs and non-native turtles is unclear, but strengthening imperiled and sensitive populations may prove to be a powerful way to increase their resilience against invasive species.

Strategy 15: Localized Eradication

Implement focused, on-the-ground projects to eradicate *bullfrogs* from specific locations. This would likely be prioritized in areas with both sensitive species and ecological characteristics to support success.

Strategy	Effectiveness	Level of Controversy	Key Actors
Localized eradication	Effective	Low	DFW

Recommendation rank: 5

In selected circumstances, eradication of bullfrogs has been shown to be achievable (it is unclear whether the same is true for non-native turtles). Other strategies short of eradication, such as invasive population reductions or limited control efforts, have also been shown to be effective at reducing competition and increasing the fitness of native populations. Limited eradication generally requires specific ecological and landscape conditions for success.

Strategy 16: Use of Private Land Eradication of Fish

Existing authorities allow DFW to cooperate with private landowners to eradicate invasive and harmful fish, which includes bullfrogs.

Strategy	Effectiveness	Level of Controversy	Key Actors
Use of private land eradication of fish	Effective	Low	Leg?, Commission, DFW, Private

Recommendation rank: 5

Regulatory action may be required to permit more effective techniques. Legislative and/or regulatory action may also be required to allow eradication of non-native turtles, as they are not classified as fish for the purposes of this activity. These types of restoration projects have a track record of success. With cooperative landowners, this strategy could extend DFW's eradication reach onto private lands.

Strategy 17: Ban Sale of Live Bullfrogs

Sale of live bullfrogs would be illegal, but dead bullfrogs could still be sold.

Strategy	Effectiveness	Level of Controversy	Key Actors
Ban sale of live bullfrogs	Effective	High	Commission

Recommendation rank: 3

While this strategy may curtail disease propagation through live markets, current customers would likely see non-live bullfrogs as inedible, effectively closing the markets down, which may lead to black markets.

Strategy 18: Point of Sale Inspections

DFW personnel would perform inspections on live markets to ensure compliance with state regulations.

Strategy	Effectiveness	Level of Controversy	Key Actors
Point of sale inspections	Potentially Effective	Medium	DFW

Recommendation rank: 4

Inspections may help curtail live markets as a vector for the introduction of invasive aquatic organisms. Inspections would also help with regulatory compliance but may be looked upon with skepticism and suspicion by live marketeers. This strategy would likely require more resources for DFW enforcement.

Strategy 20: Testing and Monitoring Regime

Develop and implement a protocol for sampling animals for sale at live markets for various diseases and/or invasive aquatic organisms.

Strategy	Effectiveness	Level of Controversy	Key Actors
Testing and monitoring regime	Potentially Effective	High	DFW

Recommendation rank: 4

Monitoring may not reveal much more than that disease is fairly ubiquitous. Still, this strategy may provide valuable insights on its true prevalence and ways to combat the introduction of disease. Surveillance may detect new strains or new diseases before becoming widespread in California. May be viewed as intrusive by importers and retailers.

Strategy 21: Increased Information Collection through Permits

Revise importation permits to gather more *information* that may be useful, such as: Where are shipments coming from? How many shipments/individuals are you bringing in under this permit? Do you have permission from the source?

Strategy	Effectiveness	Level of Controversy	Key Actors
Increase information collection through permits	Low Efficacy	Low	DFW, Commission

Recommendation rank: 2

Importers likely do not have exact numbers of imported individuals, other than extrapolating from the number of shipments. While relatively simple to enact, it is unclear how more information would be useful to achieve relevant goals.

Strategy 22: Promotion of Programs for Unwanted Animals

Implement and support places, such as sanctuaries, for pets and companion animals to be taken and kept when they are unwanted or unable to be cared for. Also includes “rehoming” organizations.

Strategy	Effectiveness	Level of Controversy	Key Actors
Promotion of programs for unwanted animals	Low Efficacy	Low	DFW, Public

Recommendation rank: 2

Some programs exist but have limited capacity and effectiveness. Creating new facilities may temporarily alleviate some releases, but total needed capacity is likely enormous. Turtles in particular are long-lived and can require extensive resources to house. “Rehoming” initiatives may work but, again, have limited capacity. However, this strategy may gain traction when bundled with other strategies.

Strategy 23: Dispatching bullfrogs in contests

In jumping frog contests, terminate all bullfrogs that are not being kept by contestants.

Strategy	Effectiveness	Level of Controversy	Key Actors
Dispatching bullfrogs in contests	Effective	High	Commission, DFW

Recommendation rank: 4

While some groups may see this as controversial, this would largely eliminate contests as vectors for disease and released individuals.

Strategy 25: Contest Monitoring/Enforcement

Deploy monitors to frog jumping contests to help guard against escapees and ensure compliance with state regulations.

Strategy	Effectiveness	Level of Controversy	Key Actors
Contest monitoring/enforcement	Potentially Effective	Medium	DFW

Recommendation rank: 3

The effectiveness of monitoring of contests for compliance with current regulations would have unclear benefits and would require substantial resources to implement. However, when paired with certain other strategies this strategy could be an important factor in success.

Strategy 28: Ban Bullfrog Imports

Enaction of a complete ban on any bullfrogs or bullfrog parts, living or dead, shipped from any source outside of California.

Strategy	Effectiveness	Level of Controversy	Key Actors
Ban bullfrog imports	Effective	High	Commission

Recommendation rank: 3

This strategy would effectively close down live markets with no mitigating strategies to keep them open; businesses that solely import bullfrogs would be eliminated. The strategy would be effective in eliminating live markets as a vector for new diseases and new strains of extant diseases. Asian communities would lose a cultural food source.

Strategy 29: Develop Commercial Harvesting

Allow and develop a market for the commercial harvest of bullfrogs and/or non-native turtles, to supplement (or supply, in the case of some type of import ban) animals for the live markets.

Strategy	Effectiveness	Level of Controversy	Key Actors
Develop commercial harvesting	Potentially Effective	Medium	Commission, DFW

Recommendation rank: 2

As with all commercial harvest of non-native species, there is a risk of inducing illegal production or of encouraging proliferation of the species. Implemented alone, this strategy

likely would remove some number of bullfrogs and/or turtles from the environment, but establishing markets for harvested animals can carry substantial risks of creating incentives to increase the presence of non-natives in the environment.

Strategy 30: Add Non-Native Turtles to Restricted Species List

Promulgate a regulation to make it unlawful to import, transport, possess, or release alive selected non-native turtle species under normal circumstances.

Strategy	Effectiveness	Level of Controversy	Key Actors
Add non-native turtles to restricted species list	Low Efficacy	High	Commission

Recommendation rank: 1

The restricted species list bans importation, transport, and possession of certain species. Import bans can be achieved by other regulatory means, and prohibition of transport and possession of non-native turtles is overly restrictive.

Strategy 31: Add Bullfrogs to Restricted Species List

Promulgate a regulation to make it unlawful to import, transport, possess, or release alive bullfrogs under normal circumstances.

Strategy	Effectiveness	Level of Controversy	Key Actors
Add bullfrogs to restricted species list	Low Efficacy	High	Commission

Recommendation rank: 1

The restricted species list bans importation, transport, and possession of certain species. Import bans can be achieved by other regulatory means, and prohibition of transport and possession of bullfrogs is overly restrictive.

Strategy 32: Prevent Water Contamination.

Implement water treatment to prevent disease and/or invasive aquatic organisms from entering the environment. Could be required for any or all of the following: import shipments, pet stores, market facilities, water from frogs or turtles in homes, and classrooms.

Strategy	Effectiveness	Level of Controversy	Key Actors
Prevent water contamination	Potentially Effective	Low	Commission

Recommendation rank: 4

The prevalence of water as a disease carrier is unknown, particularly since most water is handled by municipal water treatment systems. However, there is a possibility that some diseases and/or aquatic organisms may not be eliminated, and water treatment requirements may provide a second level of assurance via easily performed, inexpensive methods. The strategy could apply to live markets, pet owners, and/or importers.

Strategy 33: Ensure Shipments are Lawfully Obtained

Perform inspections to ensure that shipments have a valid chain-of-custody, valid health certificates when necessary, and other documentation as needed.

Strategy	Effectiveness	Level of Controversy	Key Actors
Ensure shipments are lawfully obtained	Potentially Effective	Low	DFW

Recommendation rank: 3

It is unclear to what degree, if any, shipments are not consistent with existing regulations.

Strategy 34: Inspect Shipments for Illegal Imports/Mixing Species

Imported shipments would be subject to spot testing and/or inspections for diseases and invasive aquatic organisms.

Strategy	Effectiveness	Level of Controversy	Key Actors
Inspect shipments for illegal imports/mixing species	Potentially Effective	Low	DFW

Recommendation rank: 4

This strategy would require substantial resources for DFW to implement. Disease monitoring would be possible but likely not instantaneous, and live animal shipments could not ethically be delayed if test results would require an inordinate amount of time. However, the information gained on diseases and invasives being imported would be valuable and could prompt further measures to curtail their ingress.

Strategy 12: Education Campaign 1 (Live Markets)

Establish a focused, periodic education initiative at live market vendors to instill best practices and reinforce existing regulations.

Strategy	Effectiveness	Level of Controversy	Key Actors
Education campaign 1 (Live markets)	Potentially Effective	Low	DFW, Public

Recommendation rank: 3

This strategy focuses on a key audience, but is not highly recommended in favor of a more comprehensive campaign.

Strategy 13: Education Campaign 1 (Pets)

Establish a sustained education campaign aimed at pet owners, retailers, and other relevant audiences to instill the importance of not releasing animals into the wild. Teach good animal care techniques to lessen the impetus to abandon pets.

Strategy	Effectiveness	Level of Controversy	Key Actors
Education campaign 2 (Pets)	Potentially Effective	Low	DFW, Public

Recommendation rank: 3

This strategy focuses on a key audience, but is not highly recommended in favor of a more comprehensive campaign.

Strategy 14: Education Campaign 3 (All-Encompassing)

Establish a comprehensive education campaign, or a series of campaigns, to address many different audiences and issues.

Strategy	Effectiveness	Level of Controversy	Key Actors
Education campaign 3 (All-Encompassing)	Potentially Effective	Low	DFW, Public

Recommendation rank: 4

While different lessons for different audiences can be developed, significant gains (non-duplication of effort, etc.) may be realized from a single educational campaign.

Strategy 27: Water & reservoir management

Encourage municipalities to enact ordinances to protect against bullfrogs and non-native turtles, and to manage their water features to enhance suitability for native species.

Strategy	Effectiveness	Level of Controversy	Key Actors
Water & reservoir management	Potentially Effective	Medium	DFW, Localities, Private

Recommendation rank: 4

Regulatory reforms at and near water structures could have significant effects on localized bullfrog populations, as evidenced by areas where such reforms have been implemented; however, they require the cooperation of local and county officials. DFW, in partnership with successful localities, could encourage other facilities to implement rules to limit the spread and effects of bullfrogs and non-native turtles.

Strategy Bundles

Many strategies may be better implemented together with other strategies. For example, strategies can reinforce each other, or the viability of one strategy may be dependent on the execution of another. This section incorporates draft recommendations for implementing “strategy bundles” – two or more strategies that may naturally fit together, creating a larger context for achieving a specific identified goal.

Live Markets

Bundle: Control disease and bullfrog introduction from live markets – Ban with Alternatives

Strategy	Effectiveness	Level of Controversy	Key Actors
Ban sale of live bullfrogs	Effective	High	Commission
Point of sale inspections	Potentially Effective	Medium	DFW
Encourage wild collection	Potentially Effective	Low	DFW, Commission?

Recommendation rank: 3

Mandating the sale of non-live bullfrogs would likely reduce that pathway as a vector for the introduction of new diseases. The effect of selling non-live bullfrogs on moderating diseases currently extant in California (e.g., ranaviruses, chytrid) is unknown, though introduction of new strains of the diseases would be reduced. Culturally, consuming fresh bullfrogs is important to Asian communities.

Bundle: Control disease introduction from live markets – Import Ban with Alternatives

Strategy	Effectiveness	Level of Controversy	Key Actors
Ban bullfrog imports	Effective	High	Commission
Develop commercial harvesting	Potentially Effective	Medium	Commission, DFW
Encourage wild collection	Potentially Effective	Low	DFW, Commission?

Recommendation rank: 2

Businesses that solely import bullfrogs would be eliminated. This bundle would continue the live markets, but the viability of supplanting current levels of imported bullfrogs with harvested animals is uncertain. Additionally, as with all commercial harvest of non-native species, there is a risk of inducing illegal production or of encouraging proliferation of the species; establishing markets for harvested animals can carry substantial risks of creating incentives to increase the presence of non-natives in the environment.

Bundle: Control disease introduction from live markets – Import Ban with Aquaculture

Strategy	Effectiveness	Level of Controversy	Key Actors
Ban bullfrog imports	Effective	High	Commission
Domestic bullfrog aquaculture	Potentially Effective	Low	Commission, DFW

Recommendation rank: 3

Businesses that solely import bullfrogs would be eliminated. This bundle would continue live markets with an alternate source that may result in fewer diseased frogs, and would permit monitoring and regulation of facilities. The viability of an aquaculture industry will greatly depend on favorable market conditions.

Bundle: Control disease introduction from live markets – Research and Monitoring

Strategy	Effectiveness	Level of Controversy	Key Actors
Research into release “inputs”	Very Effective	Low	DFW, Fed
Research on discharge	Potentially Effective	Low	DFW, Fed

Strategy	Effectiveness	Level of Controversy	Key Actors
Research into live food as vectors for disease	Very Effective	Low	DFW, Fed
Testing and monitoring regime	Potentially Effective	High	DFW

Recommendation rank: 5

Implementing research initiatives and developing scientifically rigorous testing approaches would fill in key knowledge gaps, adding to our understanding of the pathways for disease and releases. The information would give insights on the effectiveness of other strategies where the efficacy is unclear.

Bundle: Control disease introduction through live markets – Point of Sale Reforms

Strategy	Effectiveness	Level of Controversy	Key Actors
Point of sale inspections	Potentially Effective	Medium	DFW
Prevent water contamination	Potentially Effective	Low	Commission

Recommendation rank: 4

These strategies are focused on testing and disease controls at the live markets. Water treatment protocols are likely an easy, cost-effective way to increase assurance of wastewater not serving as a vector for diseases and aquatic organisms.

Bundle: Shipping reforms

Strategy	Effectiveness	Level of Controversy	Key Actors
Raise permit prices	Potentially Effective	Medium	DFW, Commission?
Increase information collection through permits	Low Efficacy	Low	DFW, Commission
Prevent water contamination	Potentially Effective	Low	Commission
Ensure shipments are lawfully obtained	Potentially Effective	Low	DFW

Strategy	Effectiveness	Level of Controversy	Key Actors
Inspect shipments for illegal imports/mixing species	Potentially Effective	Low	DFW

Recommendation rank: 5

In the absence of an import ban, permit and shipping protocol reforms could serve to gain more resources for DFW and increase information. The efficacy of container inspections is unclear and should be examined in more depth.

Jumping Contests

Bundle: Control disease introduction from jumping contests

Strategy	Effectiveness	Level of Controversy	Key Actors
Dispatching bullfrogs in contests	Effective	High	Commission, DFW
Contest monitoring/enforcement	Potentially Effective	Medium	DFW

Recommendation rank: 4

While some groups may see this as controversial, these strategies would largely eliminate contests as vectors for disease and released individuals. Enforcement, while requiring additional resources for DFW, would increase the compliance and, therefore, the effectiveness of the strategy.

Ecological Strategies

Bundle: Direct biological intervention

Strategy	Effectiveness	Level of Controversy	Key Actors
Research into population control techniques	Potentially Effective	Low	DFW, Fed
Habitat improvement	Potentially Effective	Low	DFW
Localized eradication	Effective	Low	DFW

Strategy	Effectiveness	Level of Controversy	Key Actors
Use of private land eradication of fish	Effective	Low	Leg?, Commission, DFW, Private

Recommendation rank: 5

While generally localized in scope, on-the-ground restoration activities are likely the best way to reduce bullfrog and non-native turtle populations. These activities fit into existing DFW strategies and priorities. Better integration of bullfrog and non-native turtle considerations into decision-making processes for habitat improvement locations, as well as explicit consideration of bullfrogs and non-native turtles into restoration projects may improve outcomes. These types of restoration projects have a track record of success.

Pets

Bundle: Reduction of pet releases and disease

Strategy	Effectiveness	Level of Controversy	Key Actors
Increase compliance with animal release regulations	Potentially Effective	Low	DFW
Education campaign 2 (Pets)	Effective	Low	DFW, Public
Promotion of programs for unwanted animals	Low Efficacy	Low	DFW, Public
Prevent water contamination	Potentially Effective	Low	Commission

Recommendation rank: 4

These strategies are aimed at responsible pet ownership. While the efficacy of increased compliance with animal regulations and the promotion of unwanted animal programs may be in question, their effectiveness may be enhanced by a concurrent education initiative. Water cleansing protocols may also increase the source of pets as a vector for diseases and invasive aquatic organisms. The education campaign could be swapped with *Education Campaign 3 (All-Encompassing)*.

Bundle: Education Campaign 3 (All-Encompassing)

Strategy	Effectiveness	Level of Controversy	Key Actors
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Education campaign 3 (All-Encompassing)	Very Effective	Low	DFW, Public
Promotion of programs for unwanted animals	Low Efficacy	Low	DFW, Public

Recommendation rank: 4

A comprehensive education campaign is likely the best option for education campaigns. While different lessons for different audiences can be developed, significant gains (nonduplication of effort, etc.) may be realized from a single educational campaign. The educational campaign may support the use of programs for unwanted animals, but existing programs are overutilized and under-supported and may not be able to handle large influxes of animals.