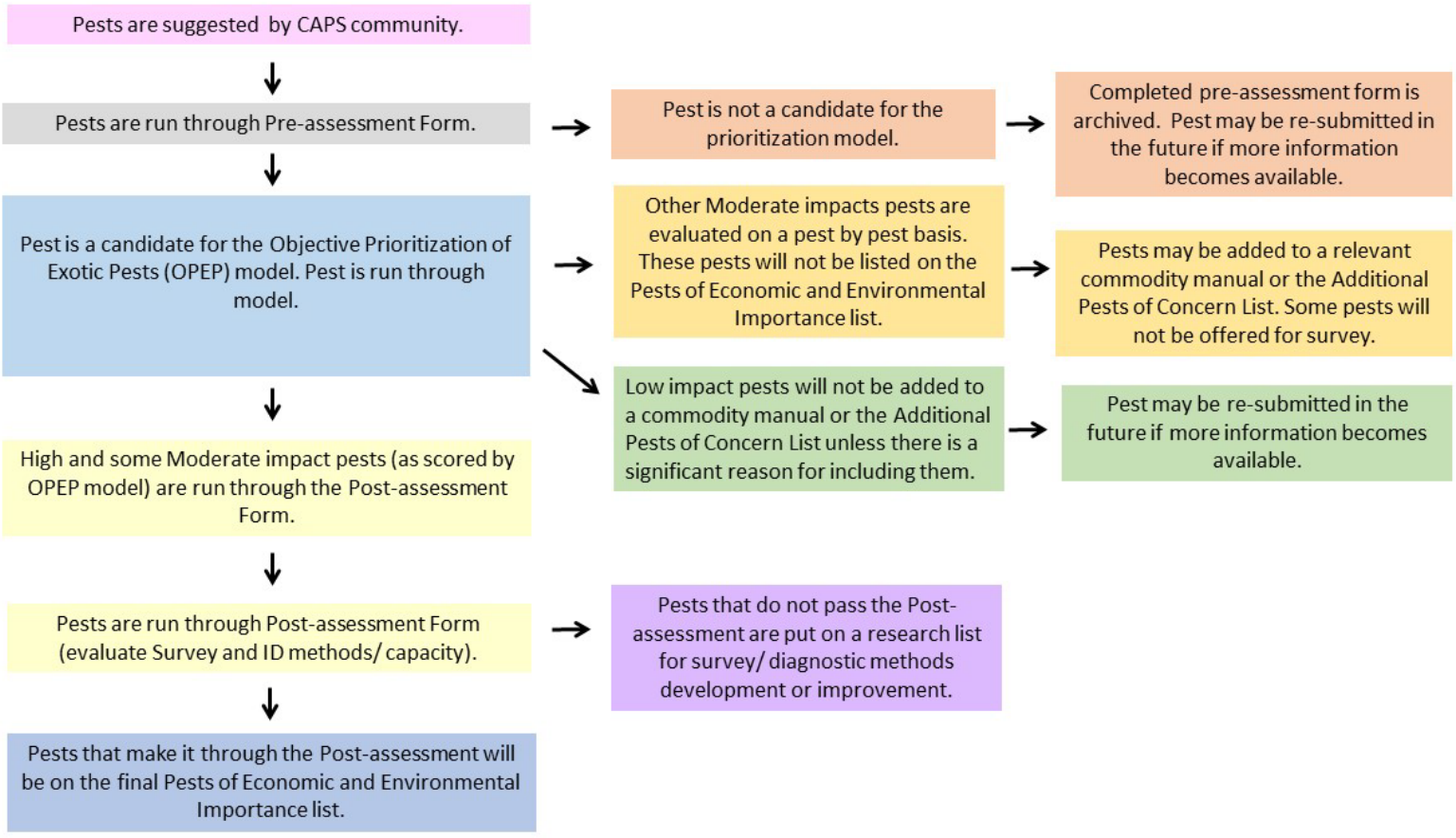
Pest Assessment and Prioritization Process

The Pests of Economic and Environmental Importance List is developed using the standard CAPS pest assessment and prioritization process: 1) Pre-assessment questionnaire, 2) Pest prioritization model, and 3) Post-assessment questionnaire. The Pre-assessment questionnaire is used to assess new CAPS pest suggestions before the pests are run through the prioritization model. The model evaluates the pest suggestions against a set of pest-specific questions. The Post-assessment questionnaire evaluates the survey and identification/diagnostics methods for pests that make it through steps one and two of the process. See the flowchart below for more details. Beginning in 2017, CPHST began using the newly developed Objective Prioritization of Exotic Pests (OPEP) model. All new potential CAPS pests will be evaluated using the CAPS Pest Assessment and Prioritization Process.

Figure 1. Flowchart of Pest Assessment and Prioritization Process



Steps in the Process

1. Pre-assessment

The purpose of the Pre-assessment is to determine if the species is appropriate for CAPS surveys. The Pre-assessment determines if: 1) the species is a plant pest; 2) the pest causes measurable damage; 3) the pest is established in the United States; and 4) there is a pathway of introduction for the pest. There is currently one version of the Pre-assessment that is used for all pest types. See pages 7 – 9 of this document for the current Pre-assessment template.

In addition, pests listed on the Pests of Economic and Environmental Importance List must conform to the following constraints:

- The pest cannot be established in the conterminous United States (even if the distribution is limited).
- The pests cannot be considered non-reportable by PPQ.
- The pest cannot be a program pest with funding for national survey.

2. Prioritization Model

PPQ Science and Technology (S&T) has developed a model for predicting pest impact, the Objective Prioritization for Exotic Pests (OPEP) model. The predictive model is based on a series of questions which require objective, documented evidence from the scientific literature to answer. Each question is scored based on its power to predict impact, and the final result is given as high, moderate, or low impact. S&T has developed a separate models for arthropods and one for plant pathogens (including nematodes). Risk criteria consist of questions focused on biology and natural history, pest damage, and research and management. The questions are in yes/no or multiple choice format, and the analyst also provides the level of uncertainty for each answer based on the quality and completeness of the evidence. Results are given in a separate section, and outputs include the predicted pest impact and the probabilities that the pest may cause high, moderate, or low impacts. There is a graph that provides a visualization of the uncertainty analysis (final scores if questions were answered differently, run through 5000 iterations). Within the assessment, in addition to the predicted impact, is a background section with information on global distribution, host range, other impacts (e.g., impacts on human health), and other information needed for a full assessment. There is a section on the endangered area, where climate and host availability are emphasized, and a section for documenting literature citations. The arthropod predictive impact model has been validated. S&T is currently validating the pathogen predictive impact model and developing an impact model specific to mollusks. S&T is also in the very early stages of developing two additional models, an economics model and a likelihood of introduction/ establishment model. Upon completion, the impact (arthropod, pathogen, or mollusk), economic, and likelihood models can be reviewed together or separately, depending on need. It is currently not known how or if the economic and/or likelihood models will influence the CAPS Priority lists.

3. Post-assessment

The Post-assessment evaluates the: 1) ease of detection of the pest; 2) the ease of identification; and 3) the available expertise and diagnostic/ identification capacity for the pest. There is currently a specific Post-assessment questionnaire for plant pathogens and arthropods. The Post-assessment is completed by a CPHST scientist in consultation with CPHST methods development labs, PPQ National Identification Service, and other subject matter experts as necessary. See pages 10 – 15 of this document for the arthropod and plant pathogen Post-assessment templates.

Pests that do not pass the Post-assessment are moved to a research list. Each year, this list is shared with the team for Farm Bill Goal Area 3 “Pest Identification and Technology Enhancement.” The specific needs (*e.g.*, a lure for a specific moth target) are documented in the Farm Bill guidance document that is posted on the Farm Bill website during the proposal open period. Farm Bill proposals that specifically address these areas of need are rated higher. In addition, these areas of need are shared with Plant Protection and Quarantine Science and Technology, and efforts are made to support methods development for these targets.

Additional Information about the OPEP Model

The following tables and charts provide additional background information on the OPEP model. In addition, the final outcome (how the pests are added to CAPS lists) is described.

I. Comparison of Models

Table 1 compares the previous model, the Analytic Hierarchy Process (AHP), used to create the Pests of Economic and Environmental Importance List and the current model, Objective Prioritization of Exotic Pests (OPEP).

Table 1. Comparison of (AHP) Model and (OPEP) Model

Analytic Hierarchy Process (AHP) Model	**Objective Prioritization of Exotic Pests (OPEP) Model**
Similarities	
The model can only evaluate pests from a known universe of pests. (We have to hear about the pests from some source.)	
If there is not much information available on the pest, it is difficult to assess the pest.	
The model may not be able to predict impact for organisms that are not currently causing damage somewhere in the world, unless they are widespread.	
Differences	
Expert opinion-driven: The AHP ranked the pests based on open-ended criteria evaluated by experts.	Evidence-driven: The model scores each pest based on how analysts answer multiple choice or yes/ no questions.
The questions were based on subject matter opinion and the weights of the questions were assigned by a subset of the National CAPS Committee.	The questions in the model have been statistically analyzed.
The value of potential hosts impacted score.	The value of potential hosts is not included.
Final product is a ranked list.	Final product is a categorization of pests into different impact groups.
The pests' scores were dependent on one another.	Each pest is scored independently from other pests.
All pest types (arthropods, plant pathogens, etc.) were analyzed in the same model with the same list of questions.	Each pest type has its own model and list of questions that have been shown to be predictive for that pest type. Scores/ categories can be compared to each other (i.e., pathogens and arthropods can all be compiled back into one list).

II. Results of the Objective Prioritization of Exotic Pests Model: Outcome for CAPS

Category 1 (High and some Moderate pests; Pests in Risk Groups A, B, C, and D)

- Pests have a significant likelihood to have a high impact in the United States. Pests have a greater than 20% probability of being a high impact pest.
- If the pests pass the Post-assessment (which evaluates the survey and identification/ diagnostic method), they will be listed on the Pests of Economic and Environmental Importance List. Pests will also be added to relevant commodity manuals.
- Pests on the Pests of Economic and Environmental Importance List are Priority Pests.
- If pests fail the Post-assessment, they will be placed on a priority list for research.

Category 2 (Other Moderate pests; Pests in Risk Groups E, F, and G)

- Pests are most likely to have a medium impact in the United States. Pests have a 10 to 20% probability of being a high impact pest.
- These pests will not be part of the Pests of Economic and Environmental Importance List.
- Pests will be evaluated on a case-by-case basis to determine if surveys are warranted. Pests that are recommended for survey and pass the Post-assessment (which evaluates the survey and identification/ diagnostic method) will be added to commodity manuals or posted as free-standing datasheets.
- If the pest is added to a commodity manual, it will be considered a Priority Pest. If the pest does not fit into an existing commodity manual, it will be added to the Additional Pests of Concern List and will not be considered a Priority Pest.
- If pests are recommended for survey but fail the Post-assessment they may or may not be listed as priorities for research.

Category 3 (Low impact or Undetermined pests; Pests in Risk Groups H, I, and J)

- Pests have a less than 10% probability of being a high impact pest.
- Low impact pests: pests are most likely to have a low impact in the United States. Undetermined pests: there is not enough information available to evaluate likely impacts.
- These pests will not be included on the Pests of Economic and Environmental Importance List.
- New pests assessed will not be included in a commodity manual or posted as free-standing datasheets unless there is a significant reason (political/ trade implications, human health impacts, etc.) for including them.
- Existing pests present in a commodity manual will likely be removed from manuals over time. These pests will still be available for bundling into other surveys.

General Timeline for developing the Prioritized Pest List

A new pest list is developed every two years. The process involves both the prioritization process to create a pest list and also development of the support tools that make the pest list "field-ready." In this way, when the pest list is made available to the CAPS community, the datasheets, approved methods, and necessary infrastructure (traps and lures, diagnostics, screening aids, etc.) are in place so that surveys can take place. See below for more details on the two-year timeline.

Year 1: Assessment and Prioritization Process

- Pre-assessments
- Model
- Post-assessments

Year 2: Develop support products for new pests

- Pest datasheets
- Approved survey methods
- Approved identification/ diagnostic methods
- Trap and lure procurement
- Identification and diagnostic capacity
- Screening aids (if appropriate)
- Host and risk maps

CAPS PRE-ASSESSMENT QUESTIONNAIRE

Scientific Name:
Common Name:
Order: Family:
Reviewer:
Date of Review:

Source of Request:
Date of Request:
Additional Information:

Question	**Decision/ Action**	**Comments/ References**
1. Is it a plant pest as defined by the IPPC? (Examples of non-plant pests would be bee pests, animal pests, structural pests, or biological control agents/ parasitoids.) **IPPC definition of "pest":** Any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products [FAO, 1990; revised FAO, 1995; IPPC, 1997] (IPPC, 2010).	YES: Go to step 2. NO: Stop.	
2. Has the pest moved to a new region or country?	YES: Go to step 3.	

	NO, but the pest causes minor damage: Stop. NO, but the pest causes major damage: Go to step 3.	
3. Does the pest cause measurable damage on any plant listed in the CAPS Host Matrix or interfere with trade for any of these hosts? Describe damage or trade issues.	YES: Go to step 4. NO: Stop.	
4. Is citrus the only important host for this pest?	YES: Stop. Refer pest to Don Seaver (CPHST). NO: Go to step 5.	
5. Is the pest exotic to the United States? (If the distribution of the pest is limited in the United States, it may be added to an appropriate commodity manual. Determination of limited distribution will be conducted on a case by case basis. Example: if a cotton pest is distributed in 4 of the 5 cotton-producing states, then this would be considered widely distributed.)	YES: Go to step 6. NO: Stop. Consider adding to a commodity manual if of limited distribution.	

6. Is it listed in the AQAS database as non-reportable at the species level? (If the pest is not listed in the database or only listed at the genus level, mark "NO.")	YES: Stop. NO: Go to step 7.	
7. Is there a demonstrated pathway of introduction, not including smuggling (e.g., interception records in PestID, literature supporting its movement to new countries, a demonstrated pathway for similar species, etc.)? (Focus on pathways of *introduction.* The emphasis is pathways through which the pest is likely to establish not just pathways of entry.) List out pathways, if known.	YES: Run through model. NO: Go to step 8.	
8. Is the deliberate smuggling of this pest or any host of this pest likely to occur? For example, is there non-traditional trade of this pest (e.g., for religious purposes, in the pet trade industry, etc.) or is the pest's host material highly valued by gardeners, collectors, or breeders?	YES: Run through model. NO: Stop. (Any smuggling would be incidental, such as for personal consumption, and unlikely to result in establishment of the pest.)	
Conclusion:		

CAPS Post-assessment Questionnaire for Insects

Scientific Name of Pest	
Common Name of Pest	
Pest List	
Name of Reviewer	
Survey Method Reviewer	
ID Method Reviewer	
Date Review Completed	
Recommendation	

This questionnaire will be for pests that have passed the Pre-assessment and have gone through the AHP model. It will assess the availability of survey and identification methods and capacity. CPHST will conduct literature reviews and work with NIS and the domestic identifiers to answer these questions. A pest must "pass" all three sections to remain on the final AHP list.

1. Ease of detection for this pest:

A. A highly efficient method is available.

- A species-specific lure is available.

Example: moth pheromone lures.

If A, keep on ranked list.

B. A moderately efficient method is available.

- A non-specific trap or lure is available.

Example: sticky trap without pheromone, ethanol and/or alpha-pinene in multi-funnel trap.

If B, keep on ranked list and refer to CPHST for method improvement. Consult with CAPS leadership and CPHST Otis lab on cost/benefit of method improvement research.

C. Current survey method is inefficient.

- No trap or lure is available. Survey is by visual observation or other passive survey method (sweep net sampling, pitfall traps, etc.).

Example: Visual observation for true bugs or scale insects.

If C, keep on ranked list and refer to CPHST for method improvement. Consult with CAPS leadership and CPHST Otis lab on cost/benefit of method improvement research.

D. It is not possible to declare negative data from current survey method.

- No specific sign or symptom is visible.

Example: Wood-boring/ bark beetles with signs of damage that resemble abiotic stress or native species; life stage of insect may not be present…how do we get truly negative data?

If D, remove from ranked list, place on "research list" and refer to CPHST for method improvement. Consult with CAPS leadership and CPHST Otis lab on cost/benefit of method improvement research.

2. Ease of identification:

A. A highly efficient method is available.

- Pest has unique characteristics and sample does not require dissection or additional preparation.

If A, keep on ranked list.

B. A moderately efficient method is available.

- Identification can be performed by a Domestic Identifier (does not need to be routed to taxonomic expert). Sample does not require dissection or additional preparation.

If B, keep on ranked list.

C. Identification is difficult or extremely time-consuming.

- A taxonomic expert is needed and/or sample requires extensive preparation.

If C, keep on ranked list and refer to CPHST/NIS for method improvement.

D. Identification to the taxonomic level needed is not currently possible.

- Life stage needed for identification is not likely to be found with current survey method, or morphological characters are not sufficient to differentiate from similar species.

If D, remove from ranked list and refer to CPHST/NIS for method improvement.

3. There is sufficient capacity and available expertise to identify the pest should a large scale survey be conducted:

Examples: There are experts available (with sufficient time available) to conduct higher level identifications.

Yes: Keep on ranked list.

No: Remove from ranked list and refer to CPHST/NIS to: 1) develop screening aids and other tools; or 2) increase capacity.

CAPS Post-assessment Questionnaire for Pathogens

Scientific Name of Pest	
Common Name of Pest	
Pest List	
Name of Reviewer	
Survey Method Reviewer	
ID Method Reviewer	
Date Review Completed	
Recommendation/Conclusion	

This questionnaire will be for pests that have passed the Pre-assessment and have gone through the AHP model. It will assess the availability of survey and diagnostic methods and capacity. CPHST will conduct literature reviews and work with NIS and the domestic identifiers to answer these questions. A pest must "pass" all three sections to remain on the final AHP list.

1. Ease of detection for this pest

A large percentage of the plant pathogens will employ a visual survey method to detect the pest.

A. Most effective:

i. A field-based screening method/assay (*e.g.*, ELISA, immunostrip) is available for the pest (often only available at the genus level), which will allow rapid screening of suspect symptomatic plant material for a pest,
ii. A visual survey protocol has been developed for the pest/disease by CPHST,
iii. A symptomatic screening aid is available to aid in survey, **or**
iv. The disease/pathogen has characteristic symptoms/signs, which enable it to be easily/readily distinguished from other endemic/native pests.
    - The disease/pathogen may have a combination of symptoms/signs that are characteristic of the disease/pathogen

If A, keep on ranked list.

B. Moderate to low-level of effectiveness:

i. No field-based screening method is currently available, **and**

ii. The disease/pathogen has symptoms/signs that are routinely present but they are not necessarily distinct or characteristic (could be confused with native/endemic pests).
    - Based on how easily the plant host can be surveyed and how characteristic the symptoms/signs are based on other endemic pests, visual survey could range from low-level to moderately effective.

If B and moderate level of effectiveness keep on ranked list refer to CPHST for method improvement.

If B and low level of effectiveness, remove from ranked list, place on research wait list, and refer to CPHST for method improvement.

C. No visible symptoms/signs routinely present:
   i. No field-based screening method is currently available, **and**
   ii. The disease/pathogen does not cause symptoms in a host of economic concern or it has a very long latent period.

If C, remove from ranked list, place on research wait list, and refer to CPHST for method improvement.

Supporting Information for Ranking:

2. Ease of identification

A. Most effective
   i. Easy to isolate/culture (if applicable),
   ii. A morphological screening aid or a validated- diagnostic methods are available for screening and/or final identification, **or**
   iii. Overall it is easy to identify organism.

If A, keep on ranked list.

B. Moderately effective
   i. Morphological identification is possible with some expertise or use of keys **and/or**
   ii. Identification is likely with literature-based molecular diagnostic methods (well-vetted, reliable, and accurate but not validated by Beltsville).

If B, keep on ranked list and refer to CPHST/NIS for method improvement.

C. Low level of effectiveness

i. Identification is difficult or extremely time-consuming morphologically (difficult to isolate; easily confused with many native/endemic pests, etc.),
ii. Identification to the taxonomic level needed is not currently possible, **and/or**
iii. Literature-based methods lacking or not well-tested.

If C, remove from ranked list, place on research wait list and refer to CPHST for method improvement.

Supporting Information for Ranking:

3. Diagnostic Capacity

i. There is sufficient capacity and available expertise to identify the pest should a large scale survey be conducted.

Yes: Keep on ranked list.

No: Refer to CAPS core members and Joel Floyd to determine if the necessary support and capacity can be developed for the survey including.

1) Validation diagnostic methods;

2) Development screening aids or other tools; or

3) Increasing capacity.