So someone saw a hornet…

There are several resources available to help you identify suspect hornets. Each resource has drawbacks and benefits, and will require different skills and tools for effective use. This document is designed to help the user find the appropriate identification tool, and be alert to its limitations.

Reverse-image search
e.g. https://www.google.com/imghp?hl=en

Best used to look for already-existing images being reposted by a submitter. Can also be used to jump-start your ID process.

+ Microscope not required
+ Specimen not required

- Not usually reliable for an ID

This picture was taken from the internet and submitted to WSDA as a potential sighting. Reverse-image searching can quickly identify images already on the internet.

iNaturalist
https://www.inaturalist.org

Best used to jump-start your ID process

+ Microscope not required
+ Specimen not required
+ Automated process
+ Mobile app available

- Image quality is a limiting factor.
- Will suggest totally bogus IDs, so be cautious!

iNaturalist incorrectly suggests this cicada killer is a yellowjacket, but the program was able to correctly identify cicada killers from better photographs.

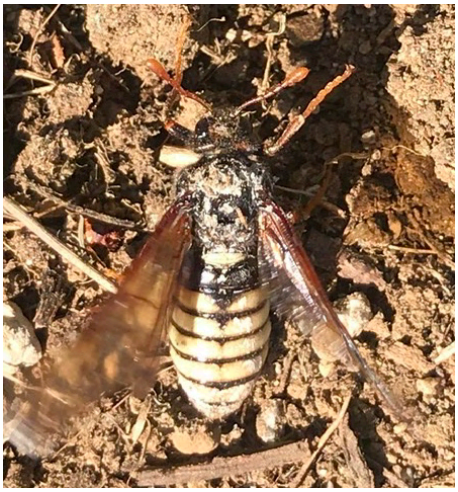
Pro-tip: Always do further research, including using more sophisticated ID aids, before basing any ID on this resource. The desktop version is not so easy to use when searching for IDs – we stick to the mobile app.

Bugguide
https://bugguide.net

Can be used to quickly scan insects known from your area.

+ Microscope not required
+ Specimen not required
+ Further information and references usually available on species pages.

- Seldom a slam-dunk ID.



Searching for “symphyta” and “Washington” returns >500 images – but they are easy to scroll through to see if there’s anything similar.

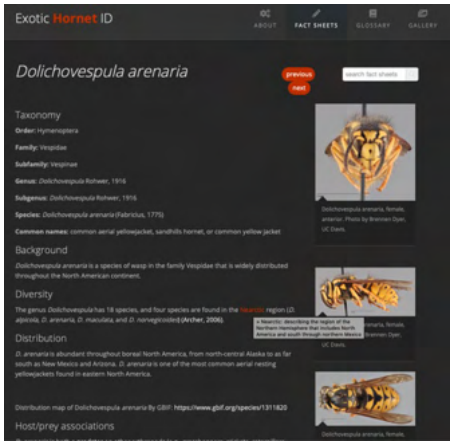
Pro-tip: Use the “advanced search” feature to limit images to your geographic area and/or the insect taxa of interest.

idTools: Exotic Hornet ID
https://idtools.org/id/hornets

One of a family of in-depth, online identification aids for a variety of pest groups.

+ Microscope not *always* required
+ Specimen not *always* required
+ Excellent images
+ Matrix keys will be available in the future

- Matrix keys don't always get to a single answer.
- Tool is still being developed as of May 2021



IDtools products include a detailed glossary, complete references, and a large image gallery. The pages are linked throughout, allowing users to look up scientific words without navigating away from the page.

Pro-tip: Matrix keys take advantage of database technology to allow users to select many characteristics at the same time, so things like color can be used alongside difficult to see morphological features. That also means there might be several species with the characters you selected, unlike the forced choice of most dichotomous keys. If you arrive at a group of several potential suspects, explore picture matching, geographic range, and those hard-to-see characters to further narrow the options.

Other specific IDtool websites that will be helpful for identifying suspect hornets include:

Exotic Bee ID - http://idtools.org/id/bees/exotic/
Sawfly genus - https://idtools.org/id/sawfly/index.php

The diversity of hornets in the genus *Vespa* (Hymenoptera: Vespidae; Vespinae), their importance and interceptions in the United States

Smith-Pardo AH, Carpenter JM, Kimsey L. 2020. *Insect Systematics and Diversity* 4:1–27 doi: 10.1093/isd/ixaa006

+ Organizes the many synonyms and summarizes hard-to-find literature.
+ Provides a dichotomous key to all *Vespa* species.
+ Includes a brief summary of each Vespa species.

- Microscope or hand lens required for most characters.
- Uses specialized morphological terminology.

The paper includes color illustrations of almost all characters used in the dichotomous key.

Pro-tip: Identified reference specimens make using this resource much easier. Many couplets in the key rely on color and body morphology – you can identify a specimen missing all of its wings and legs!

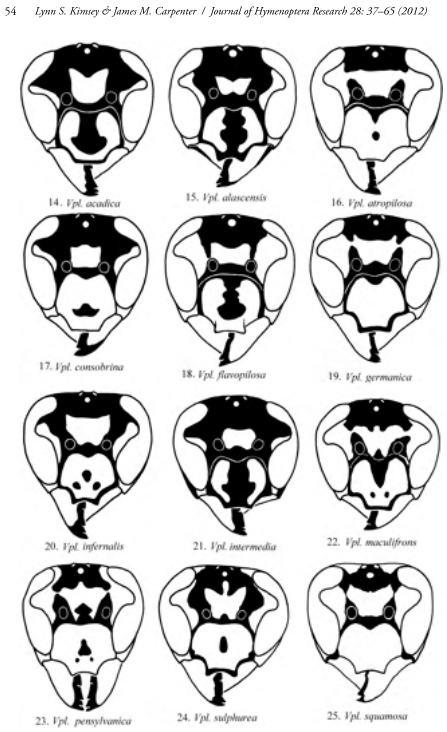
Both of these submissions were pretty easy to identify. However, you can't move these specimens easily through the Smith-Pardo et al key – many of the features that that key relies on can't be seen here. Even so, images in the paper, individual couplets, and the species summaries can still be used with these pictures to come to some conclusions. Check out couplet 3 and give it a try!

The Vespinae of North America (Vespidae, Hymenoptera)

Kimsey L, Carpenter JM. 2012. Journal of Hymenoptera Research 28: 37–65 2012 https://doi.org/10.3897/jhr.28.3514

+ In many ways, an update of Akre's 1980 key to North American yellowjackets.
+ Provides a dichotomous key to all *Vespula* and *Dolichvespula* in the US and Canada, and three *Vespa* spp.
+ Includes a brief summary of each species treated.

- Microscope or hand lens required for most characters.
- Uses specialized morphological terminology.
- Definitive identifications for some males requires examining genitalia.



Figures 14–25. Front view of face, antennae removed. *Vpl.* = *Vespula*.

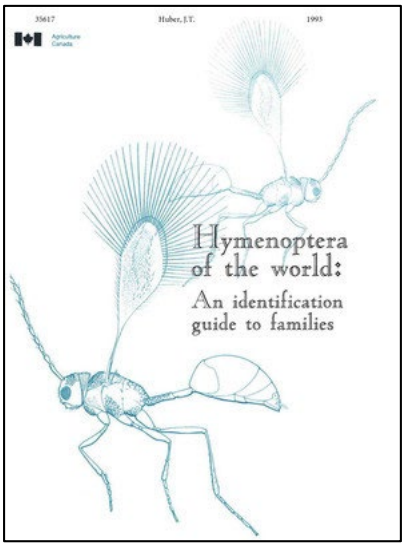
Most species are illustrated, but with line drawings rather than photographs.

Pro-tip: This resource is easiest to use with identified reference specimens for comparison. The key relies a lot on color patterns – especially for females – but be careful! There can be a lot of variability within species, so try and find several characters to support your identification.

Vespula alascensis (both pictures above) was one of the most common species we encountered in 2020. One diagnostic character is the gena interrupted by a dark spot. It is easy to interpret the specimen on the right as not interrupted, since the spot doesn't reach the eye. We needed additional characters to feel secure in our identification.

Hymenoptera of the world: An identification guide to families

Goulet H, Huber JT (eds). 1993.
https://cfs.nrcan.gc.ca/publications?id=35617



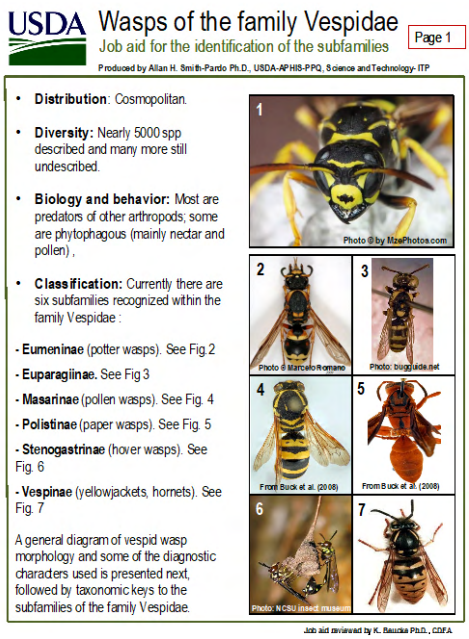
+ Dichotomous key to all Hymenoptera families (and many subfamilies) on Earth.
+ Includes an extensive and well-illustrated glossary of morphological terms
+ Excellent habitus drawings representing each Hymenopteran family, and many subfamilies.

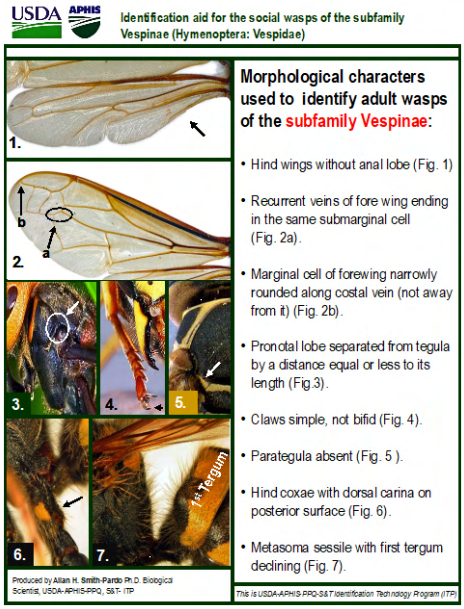
- Microscope required for most characters.
- Uses specialized morphological terminology.
- Some of the taxonomy is out of date.
- Photographs and mangled specimens may be impossible to identify with this resource alone.

Pro-tip: With this book you can identify, like, *everything* to family. Its greatest contribution though may be the illustrated glossary, which is critical to users navigating some of the more technical keys (e.g. Kimsey and Carpenter 2012). Want to know what a gena is? Look it up in Goulet and Huber.

USDA-APHIS Job Aids

USDA-APHIS-PPQ Science and Technology (S&T) - ITP





+ Designed to help port identifiers quickly identify insects at higher taxonomic levels.
+ Restricted subject matter helps users navigate the document quickly.
+ Well-illustrated with annotated color photographs.
+ Several available.

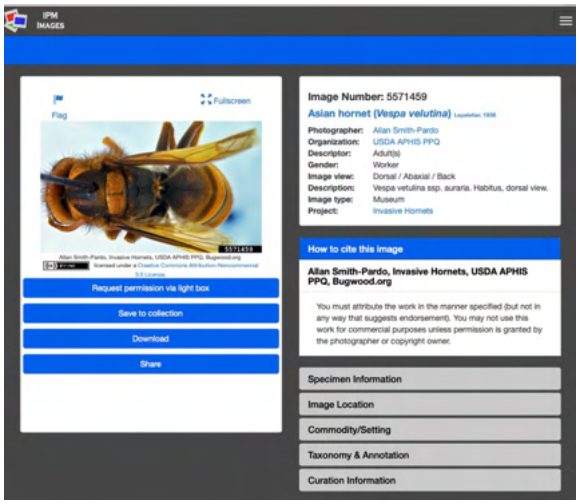
- Microscope required for most characters.
- Uses specialized morphological terminology.
- Cannot help most users arrive at a definitive genus or species ID.
- Limited subject means taxa not addressed will remain a mystery.

Pro-tip: This are like the Cliff's Notes of insect taxonomy. Designed to help port inspectors reach quick conclusions, their abbreviated content cuts to the chase of some of the other documents available (e.g. Goulet and Huber). However, there is a lot that is not in these documents, and users will almost certainly want to consult other sources to be able to say what a specimen is (rather than just what it isn't).

Bees of the United States
https://www.ipmimages.org/browse/projectthumb.cfm?proj=1154

Invasive hornets
https://www.ipmimages.org/browse/projectthumb.cfm?proj=1159

+ Gobs of high-quality images.
+ For many species, numerous specimens are photographed, capturing variability across the group.
+ Can search images by common and scientific name.
+ Includes detailed information about the specimen.
+ Many images are available for non-profit use.



- Diagnostic information is not provided, just images.
- The projects are curated collections of images stored on the bugwood/ipmimages website. It is easy to click off of the project and end up lost in the enormous catalogue of images.

Pro-tip: This is a great site for getting a feel for how variable species are. If you dive into the voluminous bugwood site you can also find what a species might look like if photographed in the field, rather than a museum or lab. Because there are no diagnostic guidelines provided, this is best used in concert with the monographs and other identification-specific material.