



Forest Service
U.S. DEPARTMENT OF AGRICULTURE



Forest Health Detection Survey









GIS Handbook and Data Conformity Standards Version 1.0

Document Revision

Apart from the process for requesting changes to Code Tables/QuickKeys, other recommendations for changes and improvements to this document will be submitted in writing to the appropriate Regional and/or National GIS Coordinator. Scope of change and the survey systems affected will dictate extent of review and approval by regional and national staff having oversight (these may also include regional leadership, FHM Coordinators, regional and national program leads for survey and remote sensing). The Continuing Support Plan for DMSM shall provide for the identification of bug and feature requests, and the process by which those are prioritized and addressed in future versions of DMSM. Linked documents will be updated as needed. Date of revision will be documented in the linked document and not in this handbook. Updates to this handbook will be evaluated yearly if needed. Revisions to this handbook are tracked below:

Revision number	Date	Affected sections
1.0 (initial)	12/6/2021	All
	8/12/2022	All-hyperlinks domain name change from fs.fed.us to fs.usda.gov

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Standards for Forest Health Detection Survey Data

The following are **the national standards for Forest Health detection survey data** inclusion in the National Insect & Disease Survey (IDS) database.

LEGEND For quick reference, Click Standards icon(s) or icon heading(s) to return to the Standards descriptions.

Icon	Description and link to referenced location(s) in document
	Green Icon symbolizes Standard #1: Survey Calendar ↓
	Light Blue Icon symbolizes Standard #2: Software Business Rules ↓ & Code Tables ↓
	Red icon symbolizes Standard #3: Submitting Non-DMSM Data ↓
	Yellow icon symbolizes Standard #4: Data Reviewer for DMSM ↓ & Post-Survey Data Processing ↓

STANDARD #1: SURVEY CALENDAR

The data represents geographic information about tree damage from the current survey season. Data can be submitted after end of the pest year (see calendar in the handbook), however, it may not be included in national summaries for that survey year. Standard #1 [Survey Calendar](#)↓ referenced location within document.

STANDARD #2: SOFTWARE BUSINESS RULES & CODE TABLES

Most detection survey data collected during aerial surveys and ground surveys is gathered using the DMSM system which enforces the data standards within the application. **Detection data collected outside of the DMSM system can be submitted and included in the IDS database if the standards are met and data are submitted in the IDS submission template.**

Standard #2 [Software Business Rules](#)↓ and [Code Tables](#)↓ referenced locations within document.

- The data must include attributes and valid codes as described in this document - GIS Handbook and Data Conformity Standards for Forest Health Detection Survey.** These required attributes are detailed in the spreadsheet included in the IDS submission template for non-DMSM collected data.

Attribute	Type	Valid Values	Description
Survey Year	Short Integer	Four-digit year like 2021	Year survey was conducted
Region ID	Long Integer	1 - 10	Region identifier
Date/Time	Date	Use full DATETIME like "11/13/2018 4:59:56 PM"	Date/time of collection of feature, clock time is optional

Attribute	Type	Valid Values	Description
Damage Type	Long Integer	Damage type code list	Damage type
Damage Causal Agent (DCA)	Long Integer	Damage causal agent code list	Damage causal agent
Host (or Host Group)	Long Integer	Host/host group code list	Host/host group
Damage Intensity (Polygons, grid cells)	Short Integer	1 = Very Light (1-3%) 2 = Light (4-10%) 3 = Moderate (11-29%) 4 = Severe (30-50%) 5 = Very Severe (>50%)	Damage intensity
Number of Trees (Points)	Short Integer	1 = 1 trees 2 = 2-5 trees 3 = 6-15 trees 4 = 16-30 trees 5 = >30 (31-99) trees Number of trees code list unless actual tree count	Code for number of trees range or integer for specific tree count: one or the other required, but not both
Estimated Point Acres (Points)	Double	Number of Trees 1 = 0.25 acre Number of Trees 2-5 = 0.25 acre Number of Trees 6-15 = 1 acre Number of Trees 16-30 = 1 acre Number of Trees >30 = 2 acres	Area represented by the point. Regional/state variations permissible
Published Status	Short Integer	0 (or NULL) = No 1 = Mid-season draft 2 = Final	Data status must be Final to be included in national dataset, otherwise it will be excluded
Source	Text	91 = REMOTE SENSING 92 = NON_DMSM_GROUND 93 = NON_DMSM_OTHER	Source code for non-DMSM collected data. Enter only numerical code
US Area	Text	CONUS Alaska Hawaii Puerto Rico	Area of non-DMSM collected data

- b. **Survey boundary data, such as a buffered flightline, ground track, or imagery extent, must accompany all submissions**, including data derived from imagery, to distinguish areas without damage from those not surveyed. These required attributes are detailed in the spreadsheet included in the IDS submission template for non-DMSM collected data.

Attribute	Type	Valid Values	Description
Survey Year	Short Integer	Four-digit year like 2021	Year survey was conducted
Region ID	Long Integer	1 - 10	Region identifier
Start Date	Date	Use full DATETIME like "11/13/2018 4:59:56 PM"	Start date/time of survey of area, clock time is optional

Attribute	Type	Valid Values	Description
End Date	Date	Use full DATETIME like "11/13/2018 4:59:56 PM"	End date/time of survey of area, clock time is optional
Flight Notes	Text		Notes to track input dataset, including Scan and Sketch (SNS) metadata
Source	Text	91 = REMOTE SENSING 92 = NON_DMSM_GROUND 93 = NON_DMSM_OTHER	Source code for non-DMSM collected data. Enter only numerical code
US Area	Text	CONUS Alaska Hawaii Puerto Rico	Area of non-DMSM collected data



STANDARD #3: SUBMITTING NON-DMSM DATA

Alternative survey methods such as automated remote sensing/image processing or visual interpretation of imagery can be used as part of the detection survey coverage. However, until alternative survey methods have been properly benchmarked, the data submitted to IDS from these various techniques must be independently verified against additional information, such as ground observations, field reports, NAIP, or other high-resolution imagery collected on or around the damage event. Standard #3 [Submitting Non-DMSM Data](#)↓ referenced location within document.



STANDARD #4: POST-SURVEY DATA PROCESSING

Data must meet Quality Assurance/Quality Control verifications. Data editing tools for use in ArcGIS have been developed to help facilitate editing data to meet these specific QA/QC requirements. The primary QA/QC rules are listed below. The complete list and specific requirements are outlined within this document and the Data Reviewer supplement. Data must be checked for the following issues and resolved if found. Note that the Data Reviewer tool described can be used to identify these situations, however other tools can also be used. Standard #4 [Data Reviewer for DMSM](#)↓ and [Post-Survey Data Processing](#)↓ referenced location within document.

- All required attributes must be populated.
- Multiple observations per feature are allowed except:
 - » Multiple observations will not have the same host and damage type.
- Overlapping polygon features are allowed in the national database where appropriate.
- Multipart polygons are not allowed.
- Sliver polygons must be fixed.
- Records contested with different observations from ground or other sources must be resolved.
- Duplicate point features are not allowed.

Introduction

The Cooperative Forestry Assistance Act of 1978, as amended through 2008, Section 8, [16 U.S.C. 2104] FOREST HEALTH PROTECTION, authorizes the Forest Service to "conduct surveys to detect and appraise insect infestations and disease conditions and man-made stresses affecting trees and establish a monitoring system throughout the forests of the United States to determine detrimental changes or improvements that occur over time, and report annually concerning such surveys and monitoring".



Image: Digital Mobile Sketch Mapping User Interface (left) and photo of aerial surveyor (right).

Detection surveys are the primary method of collecting data on the health of treed areas affected by insects and diseases. Typical methods of detection surveys include the aerial detection survey program, various forms of ground survey, and developing use of remote sensing (satellite/sensor based). The geospatial data collected during detection surveys, primarily from aerial and ground methods, are stored in a National Insect and Disease Survey (IDS) database. Various products are available for download including National IDS Survey Maps, IDS Geospatial Data, and IDS Acre Summaries. The annual detection survey data are used by local units and regions to inform land managers of new activity and characterize the health of the forest within the local area. On a national scale, the data are also used to produce various reports including the Forest Insect and Disease Conditions in the United States reports and National Forest Health Conditions & Highlights.

Detection surveys do not provide a full inventory of tree damage, but rather are an efficient and economical method of collecting and reporting out on the presence, extent, and severity of forest disturbances from insects, diseases, and other agents across state, private, and federal lands. Aerial detection surveys are instrumental in detecting and locating emerging threats from insect and disease and in the prioritization/location of insect and disease mitigation opportunities. Although ground-based surveys can and do support detection surveys, some are designed to capture individual tree level details not accommodated in the IDS database which is currently structured for broad-scale, detection-level reporting. Standards for detailed, individual tree-specific, ground surveys and the extent to which these contribute to national forest pest conditions reporting are being evaluated for future use.

This handbook is a reference for GIS specialists/coordinators managing annual [Detection Surveys](#). This handbook updates the '[Aerial Survey Geographic Information System Handbook: Sketchmaps to Digital Geographic Information](#)' (2005) and accompanies the '[Aerial Survey Standards](#)' (1999). Together this GIS handbook and the aerial survey standards address technical data conformity topics and survey conformity standards, such as damage types that must be recorded versus those that are optional. This handbook deals exclusively with data conformity and management concerns; it does not provide guidance on survey standards. Conformance and calibration meetings are forums for discussion and training on survey standards and more detailed regional protocols. The last comprehensive effort to document survey best practices, '[A Guide to Conducting Aerial Sketchmapping Surveys](#)', was published in 2000.

These documents were written in the context of paper sketchmapping and by 2005 included use of the Digital Aerial Sketchmapping (DASM) application. Whether using paper-based sketchmapping or DASM, these methods allowed surveyors great flexibility as to how data was initially collected during surveys. That flexibility in collection protocol drove the need for documented GIS standards to guide GIS specialists on how to translate diverse data structures into a consistent national IDS database.

The Digital Mobile Sketch Mapping system (DMSM) has been in use since 2016. DMSM is comprised of both tablet hardware and software, supported by custom ArcGIS desktop tools, that are used by trained surveyors to record forest disturbances and their causal agents. The DMSM software enforces data standards for complete and valid attribution at the time of collection.

With the adoption of DMSM, meeting the requirements for submitting data that meet national IDS standards have been simplified. If surveyors use the DMSM tablet application and/or the DMSM Desktop Tools (DTT) to create and edit GIS data, check-ins of their data via those systems will meet basic national IDS standards. In cases where survey data are collected outside of the DMSM systems, data must be submitted for national reporting using the [Insect & Disease Survey \(IDS\) data submission template](#), a file geodatabase template with basic core feature classes that conform with the DMSM database.

The goal of this handbook is to provide a succinct roadmap to critical information currently dispersed across a long and growing list of tools, manuals, presentations, web pages, and technical papers. As technology and procedures evolve and relevant resources referenced in this document will be replaced or revised, existing links in this document will be updated.



Code Tables for Core Attributes

All damage features require core attributes: Survey Year, Region ID, Date, Damage Type, Damage Causal Agent, Host (or Host Group), Damage Intensity (percent of canopy affected for areas), Number of Trees (for points), Estimated Point Acres (for points), Source, and US Area. The list of valid codes for these core fields can change over time. Retired codes cannot be used; however, they are retained in the IDS archive for analyses of historical survey data

Damage Type

Damage type codes are stored in the "DAMAGE_TYPES" table of the DMSM database. For easy reference all damage type codes are also kept in a [Damage Type Code List](#) Excel workbook which includes separate tabs showing:

- **Current Damage Types:** Valid codes for data input
- **Code List:** The full code list includes retired codes which are useful when analyzing the complete 1997 – present IDS archive.

With the notable exception of defoliation, the current valid list of damage types is mostly unchanged from prior pre-DMSM standards. Refer to [DMSM – Making the Defoliation Call](#) for details on current defoliation coding. Current damage types do not address within tree damage such as cankers.

Damage Causal Agent (DCA)

DCA codes are stored in the "DAMAGE_CAUSING_AGENTS" table of the DMSM database. For easy reference all DCA codes are also kept in a [DCA list](#) Excel workbook which in addition to a 'Notes' tab, contains 3 data tabs:

- **Full Current DCA list:** Complete list of the over 1,000 Damage Causal Agent (DCA) codes as of the version number and date listed in the workbook.
- **DMSM Regional DCA shortlist:** A subset of the full DCA list considered relevant for survey. These codes are valid for data input into DMSM as of the version and date listed in the workbook. For each DCA, the table shows its membership in one or more Regional DMSM DCA short lists.
- **IDS DCA list** (*Includes retired codes*): Useful when analyzing historical data in the IDS archive (1997 - Present) where older records can use now retired DCA codes.
 - » For background detail on DCA changes since 2015 see the [DCA Additions Revisions](#) workbook.
 - » Additions or corrections to the full DCA list can be made using the [DCA Change Request form](#). Update and change requests are due by March 15th for inclusion into DMSM and the upcoming field season.

HOST (and Host Groups)

Host codes and groups are stored in the "HOSTS" and "HOST_GROUPS" tables of the DMSM database. For easy reference all host and host group codes are also kept in a [Host List](#) Excel workbook which in addition to a 'Notes' tab, contains 3 data tabs:

- **DMSM_HostList:** Host Species Codes that are valid for data input into DMSM. For each tree species, the table shows its membership in one or more Regional DMSM host short lists. Codes are derived from a larger Forest Inventory Analysis (FIA) reference species list. If tree species needed for survey are not on the FIA tree list, partners can contact [FHAAS](#) with addition requests. Partner requested, non-FIA listed, tree species are assigned a 9900 series code.
- **DMSM_HostGroups:** To accommodate cases where a DCA affects multiple hosts and/or where it's not possible or practical to differentiate damage for each individual tree species from the air, a "host group" code may be used. A host group is a set of no more than 5 individual tree species that share the following characteristics.
 - » Host to a specific pest or pathogen
 - » Commonly found growing together in the same stands and or at least in the same area.

In some cases, the same host group is used by many regions, but typically host groups are unique to a region. Host Group codes use a numbering convention based on Forest Service Region IDs:

- 9**0**00 series for R10
 - 9**1**00 series for R1
 - 9**2**00 series for R2
 - (same pattern for R3, R4, R5, R6)
 - 9**7**00 series for R9 (Note: 9900 series is reserved for new hosts)
 - 9**8**00 series for R8
- **Full_FIA_treelist:** This tab includes the over 2,500 species in the full FIA tree species list.

Damage Intensity (percent of canopy affected for areas, number of trees for points)

On polygons and grid cells, DMSM characterizes damage intensity as the percent of damaged trees within the perimeter of the polygon or cell that are damaged/recently dead in relation to all trees in the cell or polygon. For small groups of damaged trees captured as point features, surveyors can either use a pre-determined 5-class number range (the NUMBER_OF_TREES field) or a specific tree count (TREE_COUNT).

Table 1: Damage Intensity

CODE	PERCENT AFFECTED	CODE	NUMBER OF TREES
1	Very Light (1-3%)	1	1
2	Light (4-10%)	2	2-5
3	Moderate (11-29%)	3	6-15
4	Severe (30-50%)	4	16-30
5	Very Severe (>50%)	5	31-99

Percent affected estimates for areas

This percent or ratio can be expressed as:

$$\frac{\text{Number (area of canopy) of damaged or recently dead trees within the damage area polygon or grid cell}}{\text{Number (area of canopy) of all live and standing dead trees within the damage area polygon or grid cell}}$$

The treed area (the denominator in the percent of trees estimate) is all standing trees, not just hosts, nor just live trees but standing dead as well. In Figure 1, 'Old kill' and 'Two-year old fader' represent standing dead trees considered part of the treed area denominator:

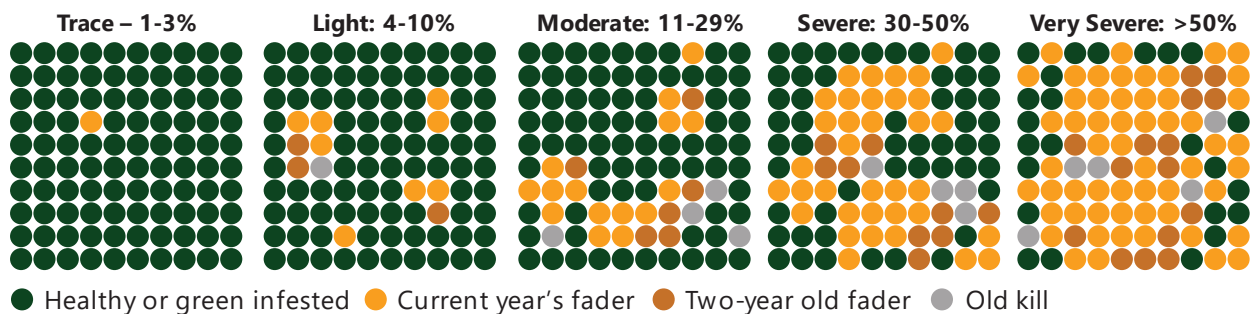


Figure 1. Percentage of Standing dead trees graphic

Non-treed areas (water, roads, meadows, etc.) may be included within the damage area polygon or grid cell, but do not factor into the percent affected call. It is the area of live and standing dead trees within the polygon or grid cell, and not the area of the polygon or grid cell as a whole, that represent the denominator in this equation.

The following images show how surveyor preference for mapping damage (lumper versus splitter, polygon versus grid cell) can result in big differences in the total 'acres-with' damage footprint. GIS specialists could consider symbolizing damage polygons and grid cells by the percent affected class to better communicate actual damage impacts on their maps.



Figure 2. Image showing mapping damage as splitter (severe). Photo by Justin Backsen.

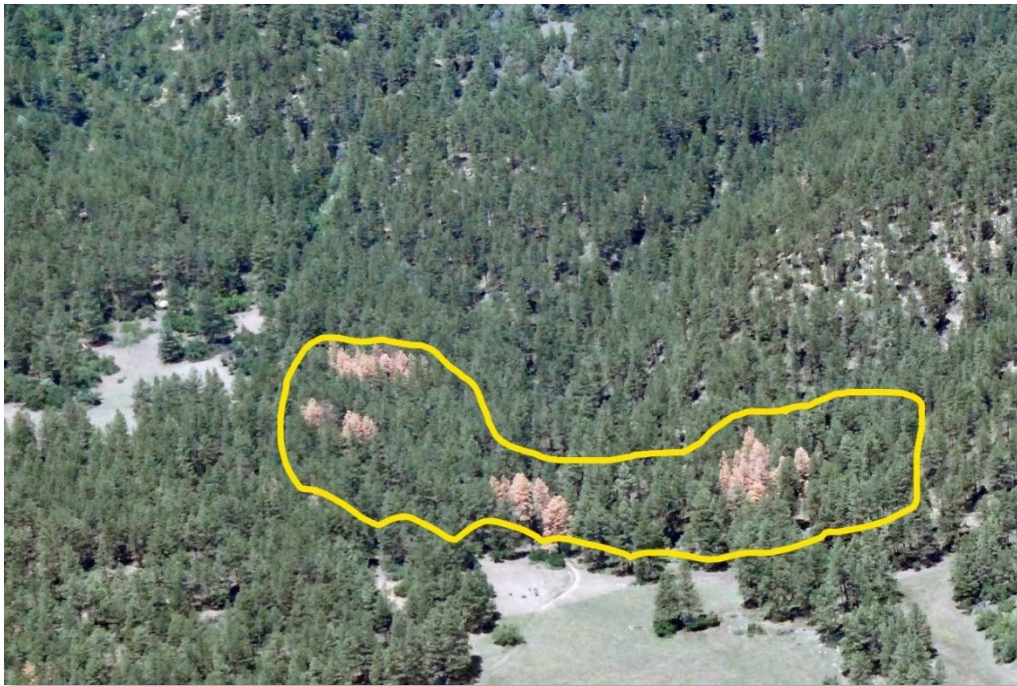


Figure 3. Image showing mapping damage as lumper (moderate). Photo by Justin Backsen.

DMSM Software

The following tools are provided for the collection, editing, and quality checks of annual IDS survey. Each tool was designed to address the needs of a specific part of the detection survey workflow. While there may be some crossover in use/function of each, their strengths (checkmarks) and limitations (in italics) are highlighted below.

DMSM Tablet Application

Custom application that runs on Android tablets. Principally designed for conducting aerial insect and disease detection surveys, but also accommodates ground surveys. Refer to the [DMSM User Manual](#) for details.

- ✓ Data collection/creation
- » *Limited editing capability* ([Guidance on Scan and Sketch data collection workflow](#))

DMSM Desktop Tools (DTT)

Custom add-in toolbar for ArcGIS Desktop that enables editing or creation of DMSM features. The custom components of DTT install feature class extensions that enforce rules as to how features can be edited. Refer to the [DMSM Desktop Tools User Manual](#) for details.

- ✓ Data editing
- ✓ Data extraction
- ✓ Data reporting
- » *Limited data collection/creation capability* ([Guidance on Scan and Sketch data collection workflow](#))



Data Reviewer for DMSM

Batch files designed for use with ArcGIS Desktop Data Reviewer extension and DTT. A comprehensive manual explains how to use these Data Reviewer checks to identify, inspect, and, if required, correct geometry or attribution issues. Refer to the manual '[Data Reviewer for DMSM and batch files](#)' for details.

- ✓ Data quality checking and corrections
- » *Used in conjunction with DMSM Desktop Tools for editing.*

Feature Types

Both DMSM and the national reporting IDS geodatabase accommodate point, polygon, and grid cell features. Acres are assigned to point features rather than buffering and creating polygons out of points.

The choice of which type of feature (points, polygons, or grid cells) surveyors use to map damage depends on their ability to identify the size, shape, and position of damage from the air and accurately render that information on a map.

- **Points** - are recommended for small clusters of tree damage.
- **Polygons** - are used when boundaries around areas of tree damage are clearly discernible from the air or ground and can be accurately oriented on base imagery or maps.
- **Grid cells** - can be used for widespread, diffuse damage with indistinct boundaries. A surveyor's choice of grid cell resolutions at 240, 480, 960 or 1920 square meters is provided to accommodate various observational scales and precision of the data. Grid cells are positionally tied to a 'fishnet' of identically sized rectangular shapes.



Software Enforced Business Rules

- **On tablet:**
 - » Can only edit your own data or enter an additional observation to a damage feature created by another user.
 - » Cannot create a feature without complete core attribution including damage type, DCA, host or host group, and damage intensity (percent affected for areas, number of trees for points).
 - » Cannot reshape grid cells.
 - » Cannot move damage points.
 - » Cannot edit flightline shapes or their attributes including user ID, date stamp, collection mode status -ground vs. aerial.
 - » Cannot edit Quick Keys (QK). Partners must work through DMSM administrators at FHAAS to load QK list updates to the central database. See [Quick Key](#) discussion for additional information.
- **On DTT:**
 - » By default, users can only edit their own data
 - There is a tool administered by FHAAS that can extend DTT edit privileges to additional designated users. Typically, state or regional GIS coordinators request that FHAAS grant edit access to all surveyors in their group.
 - » Grid cell shapes cannot be edited. DTT only allows attribute updates and/or deletions of grid cell features.
 - » Flightline attributes and shapes cannot be edited in DTT.
 - » Features with missing damage type, DCA or host attributes cannot be checked-in. See [DTT data validation](#) for details.

Databases

DMSM Production Database: A central ArcGIS enterprise geodatabase that runs on Microsoft SQL Server. DTT and DMSM tablet communicate with this database via check-outs and check-ins using ArcGIS services. The USFS Virtual Data Center (VDC) in Kansas City hosts and maintains the DMSM database and the ArcGIS Server services used by the DMSM-tablet and DTT. A new, empty, current-year, DMSM database is loaded on the server at the November 1 start of the next pest reporting year. See [DMSM database diagram](#) for details of the database structure.

DMSM Training Database: Housed at the VDC. Duplicates the production data model and can be accessed by the DMSM tablet application and DTT but the features stored in this database are not part of the production data stream and will not be used for national summaries or map displays. If production survey data is accidentally collected using this database, please contact [FHAASST](#).

IDS Database: The IDS archive goes back to 1997 and therefore must accommodate current and historical data structures. Historical data from the pre-DMSM era have attribution that includes fields no longer used, and codes for core fields that are now retired. In addition to data from DMSM, IDS accommodates other data sources including remote sensing image processing, aerial surveys that did not use DMSM, and ground surveys collected with tools like Field Maps or Survey 123. Data not collected using DMSM must meet the basic DMSM database structure as spelled out in the [Insect & Disease Survey \(IDS\) data submission template](#).

For more information about IDS including downloadable maps, reports and GIS data refer to the [Detection Surveys web site](#) web site. Data distributed from the IDS database is structured in a flat file format meaning that features with multiple observations are stored as separate “pancaked” features with duplicate geometries. For more information on flat files and accommodations for the different pre- and post-DMSM data structures, refer to the IDS_FlatFiles_Readme document.

Services

The DMSM tablet application and DTT connect to the DMSM production geodatabase via editable services. When the pest reporting year ends on October 31st, surveyors will need to switch their tablet syncing service to the new reporting year URL to upload and sync to the current year geodatabase for data collected November 1st and after. All unsynced data on tablets from the prior year should be synced as soon as possible, and no later than early November before sharing of the prior-year service is discontinued. New geodata and map services used by DTT are added each reporting year. However, unlike the DMSM tablet application which can only access the current year DMSM geodatabase via the current tablet sync service.

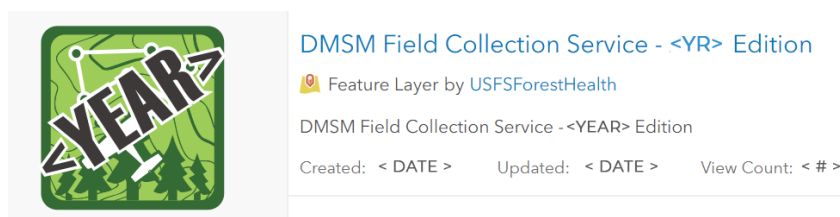


Figure 4. DMSM Field Collection Service Graphic

Updates of the Training feature service are not necessarily synchronized with the pest reporting calendar. The training URL is only updated when certain system changes are required and a change to the DMSM database is made. When users configure DTT or DMSM-tablet settings to connect to the training service they can create, edit, delete data without impact to the production database. Users need to be careful to make sure that they are connected to the appropriate database. If real survey data intended for production is inadvertently synced to 'Training' (or vice-versa) contact [FHAASST](#) to have those features transferred to the appropriate database.

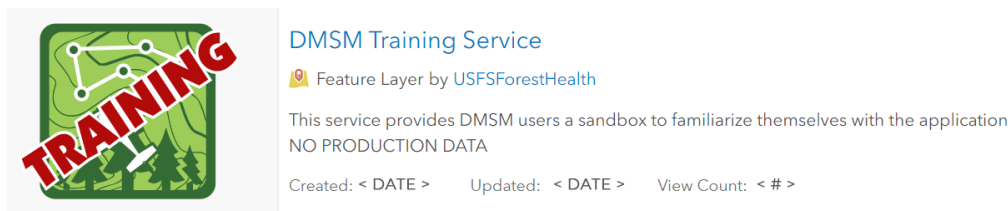


Figure 5. DMSM Training Service Graphic

All URL links to current year DMSM production and training services for the tablet application and DTT are listed on the ArcGIS On-Line [DMSM group home page](#). Only members of the DMSM ArcGIS On-Line (AGOL) group have edit access to DMSM data via those services. See the Pre-Survey Prep section below for details.

In addition to the editable services that are used to collect and edit data DMSM administrators publish several DMSM related read-only map services. A brief overview of these services follows:

- **DMSM View Only Map Service <Current Year>** : Current snapshot of all synced data. Only available to members of the DMSM AGOL group. Apart from basic communication within the DMSM AGOL group, this view-only map service can be used to verify that check-ins completed successfully. It can also be used by DMSM AGOL group members to monitor activity across states and regions to help with survey planning.

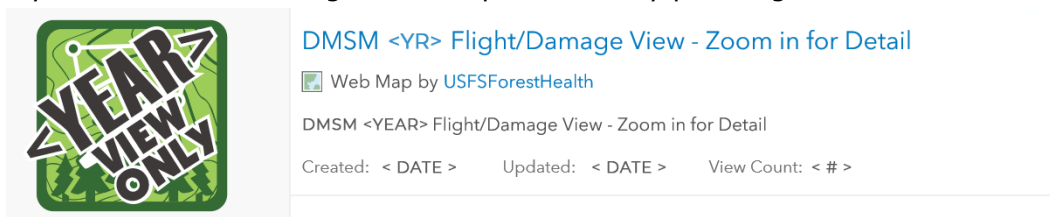


Figure 6. DMSM Flight/Damage View – Zoom in for Detail Graphic


- **Mid-season Draft Map Service <Current Year>** : During the survey season, if states/regions choose to flag damage features as "Draft" or "Final" those features will be viewable in this publicly available map service (See the '[Update PUBLISHED field](#)'  section for details). This publicly shared map service provides an option for states and regions to provide partners view-only access quickly and conveniently to draft map data throughout the survey season.



Figure 7. Mid-season Draft and Final Aerial Survey Data Map Graphic

- **ForWarn Map Service:** [Forwarn II](#) is a satellite-based program that provides near-real-time tracking of vegetation changes. The DMSM Forwarn service customizes the source Forwarn service to meet the needs of aerial survey. FHAAS has developed separate guides for utilizing this map service for survey mission planning using [ForWarn II Data in ArcMap](#) or [ForWarn II Data in ArcPro](#). ForWarn II data may not be available for all US States and Territories.

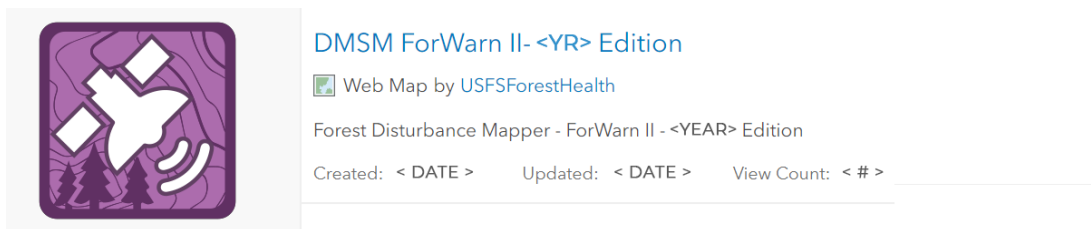


Figure 8. DMSM ForWarn II Edition Graphic

- **IDS Map Service:** Read-only map service available to the public from the USFS Enterprise Data Warehouse. Updated annually to show the prior 5 years of IDS data.



Figure 9. Insect and Disease Survey Map Image Layer Graphic

Survey Calendar

As it relates to data collection and processing, we divide detection surveys in support of national reporting into 4 stages. While activities associated with these stages can occur throughout the year, these stages are typically:

- **Pre-Survey Prep:** Late winter to early spring.
- **Data Collection:** Early summer to fall with earlier flights for spring defoliators in the eastern U.S., southern pine beetle, and Hawaii where surveys generally take place in early fall and winter. The pest reporting year ends October 31st with data collected after this date added to the following year.
- **Post-Survey Data Processing:** Data review and clean-up takes place throughout the aerial survey season but becomes more predominant in the fall. Final data submissions to national office are due November 15th.

National Forest Pest Conditions Reporting Schedule: The standard reporting schedule shown below, current as of 2021, is subject to change.

Table 2. National Forest Pest Conditions Reporting Schedule

Date	Reporting Activities
31 October	End of Pest Reporting Year – ADS Data collected after this date is assigned to the next field season.
15 November	Editing of ADS completed and final drafts.
31 January	Initial reports are entered into PER.
15 February	Regions promote agents in PER.
28 February	National promotion of PER reports. Note: Issues discovered with ADS data during the PER reporting period can lead to additional (post November 15) DTT editing.
15 March	PER compilation complete, IDS database compilation complete. Requires continued automation of workflows. Summary table for pests finalized. IDS data sent to the EDW for loading into the feature service.
15 April	Info graphic complete, forest pest range maps complete.

Pre-Survey Prep

AGOL Accounts

Each user of the DMSM tablet application and DTT must have an AGOL Organizational account (public accounts are not sufficient) and have that account added as a member of the DMSM AGOL group. Existing DMSM users may need to contact [FHAAST](#) to re-activate disabled AGOL accounts. Current cyber-security policy disables USFS AGOL accounts that have not logged in during the last 60 days.

Obtaining AGOL access for new users:

Recommendations for obtaining access to the DMSM AGOL group differ based on whether or not a user is with the Forest Service:

- **Forest Service Users:** submit a request at [USDA Forest Service GTAC - ArcGIS Online Access Requests](#). If any difficulties or questions, contact [FHAAST](#).
- **State Cooperators:** Obtain an account through your respective agency GIS staff. State cooperators with existing or newly acquired accounts through their state's AGOL organization will also need to make their AGOL accounts publicly visible by logging into [AGOL](#), clicking 'My Profile' > 'Profile Visibility' and selecting the "Everyone (Public)" option. This will enable FHAAST staff to add your account to the DMSM user group. If it is not possible to receive an AGOL account through your state organization contact [FHAAST](#).

Once an account is obtained, please contact [FHAAST](#) to be added to the DMSM group.

Request Desktop Tools Edit Permissions

By default, users only have permissions to edit their own data, but coordinators can contact [FHAAST](#) to request specific additional edit permissions for designated DTT users. Typically, state or regional GIS coordinators request ability to edit the DMSM data from all surveyors in their group. In some cases, coordinators also request extended edit privileges be added for their surveyors with advanced GIS skills. Review the DTT User Permission report for each region's current permission settings to the Production DMSM database. For training purposes, all users are "supereditors" in the DMSM training database and therefore can edit all damage features in training, not just those they created

Training/Refresh Skills

In addition to new users, existing users are encouraged to take time during pre-survey to review documentation (refer to the user manuals links in the DMSM Software section of this handbook) and the online [DMSM training](#). Users can connect to the tablet Training URL and DTT Training services to walk through procedures for data collection and syncing with the tablet, and post-processing with Desktop Tools, Data Reviewer without affecting the production DMSM geodatabase.

Current year connection info needed for use of DTT and DMSM tablet application (including the Training URLs) are found on the [DMSM AGOL home page](#).

Quick Key and Host Group Review

Quick Key lists define for a particular state, region, or survey area the DCA, Host, and Damage Type combinations that common to the survey area. Apart from changing Quick Key colors, which can be customized by the DMSM software on the tablet, Quick Keys and Host Groups must be pre-defined and loaded on to the DMSM database server ahead of data collection.

State and regional aerial survey leads and/or GIS coordinators must work through [FHAASST](#) to implement Quick Key changes on the central DMSM database. During pre-season prep, each state/region should determine if changes are needed to regional DCA and Host short lists, available Host Groups, and Quick Keys.

Implementing Quick Key change requests on the central DMSM database can be complex. Regions and States should make notes of desired improvements to Quick Keys throughout the survey season. If there is an urgent need for updates mid-season, FHAASST will do its best to accommodate. However, the preferred method is to plan for a systematic review during the off-season and working with [FHAASST](#) to get any updates implemented well in advance of flying survey. For details refer to '[Quick Key and Host Group Maintenance](#)' documentation.

Hardware Updates/Maintenance

Surveyors and GIS coordinators are encouraged to check to make sure that tablets, memory cards, external GPS units, and auxiliary power units are in good operable condition. Refer to the [DMSM Equipment Specifications and Recommendations](#) document for more information on replacement and setup recommendations.

Refer to [DMSM Samsung Galaxy Tab setup](#) for configuration details.

Install Needed Software Updates

Each year surveyors and GIS coordinators should check installed versions to see if they are up to date and match the most current software releases available. Install packages for key software are downloadable from the [DMSM AGOL Applications page](#). Including:

- [DMSM tablet application](#)
- [Data Reviewer for DMSM and batch files](#) (zip file includes user guide)
- [DMSM Desktop Tools \(DTT\)](#)
- [DTT toolbar: Quick Key tool add-in](#)

Version numbers for installed software are found on the 'About' button on the DTT toolbar and the DMSM-Tablet 'About' menu item.

Update Tile Packages (TPKs)

The base map imagery and other reference map layers used by the DMSM tablet application should be periodically updated. The DMSM tablet system requires that these layers be packaged as TPKs; TPKs are compressed zip files. To optimize performance, the base map imagery TPK must be unzipped and placed in a DMSM project's "CompactTileCache" folder. The [DMSM: How to create a TPK](#) document is a comprehensive guide for creation and deployment of TPKs for DMSM. This document includes procedures to work around ArcMap and ArcPro software limitations that typically limit the areal extent of TPKs created from image services as well as the problem introduced if creating TPKs using versions of ArcMap 10.7.1+ and ArcPro that prevents proper functioning of DMSM's moving map display.

- **Enhancing DMSM Zoom Scales**

When creating TPKs according to recommended procedures, zoom-in capability on the DMSM tablet application is limited by the level of detail of the base map imagery TPK. The instructions in '[Enhancing TPK Zoom Scales in DMSM](#)' will enable larger zoom scales. However, *this procedure is not suitable for use in aerial survey*. DMSM's moving map display will not properly refresh with an enhanced zoom scale base map.

Enhanced zoom scale base maps are a practical solution for use of DMSM in ground surveys or possibly certain helicopter surveys where quick refresh auto-pan is not critical. For users who need both tighter zoom-in capability and responsive moving map display, the only solution is to create base map TPKs with an increased Level Of Detail (LOD). To manage the larger file size of base map TPKs with higher-level LODs, GIS specialists typically create these high-resolution/tighter zoom-in TPKs for relatively small project areas. The [DMSM tablet application user's manual](#) describes how to manage multiple base maps on a tablet using separate DMSM 'Project' directories.

Data Collection

Check Settings

- At the start of data collection for a new survey season, verify that the tablet sync service is pointing to the current year production service URL as listed on the AGOL DMSM home page. Contact [FHAASST](#) if production survey data has been mistakenly synced to an incorrect geodatabase such as training or an older database.
- Before every mission, be sure that the Collection Mode, "Aerial_Survey" versus "Ground_Check", has been appropriately set.
 - » The Collection Mode setting provides useful metadata about whether a damage record was made from a ground or an aerial observation and differentiates flightlines from ground tracks. The distinction between ground tracks and flightlines is important when using DTT to create accurate surveyed area boundaries.

Sync Verification Using Web Maps

Sync performs a two-way update of the geodatabase, downloading new changes in the data from the server and uploading new data that has been collected on the tablet. When possible, a sync should be performed before and after data collections to allow access to the most recent survey data and to ensure that your survey data is being routinely loaded to the server where it can be shared with other users, reviewed, and edited. Frequent syncs keep uploads and downloads of newly created data as small as possible, which shortens sync times and reduces risks for mid-sync failure. If syncing is not possible due to lack of connectivity, the data can be synced at another time, but may take longer to complete as unsynced survey data builds up.

Since the DMSM sync relies on Wi-Fi, and those internet connections can sometimes be weak or interrupted, we encourage users to inspect the [<Current Year> View-Only web map](#) to verify that all data from the tablet successfully transferred to the server.



Figure 10. DMSM Flight/Damage View Graphic

Data Off-load Procedures in Cases of a Sync Problem

Technical issues occasionally prevent successful syncs of data from the tablet to the central DMSM geodatabase, or users may inadvertently load a new geodatabase before syncing data on the tablet to the server. To protect from data loss, DMSM automatically backs up the database at every sync or geodatabase re-load. In addition to these default backups users can opt to log backups when building flightlines which can be used to recreate flightlines if there are problems with the 'Build Flightlines' tool. The backups are stored on the SD card > Android > data > com.masonbruce.dmsm > GDB_backups folder. Refer to [Off-load procedures](#) documentation for details.

Ground Checks

The DMSM tablet application can be used for aerial and ground surveys. Because of DMSM-enforced business rules that prevent a different user from editing the shape or observations of a feature created by another, ground checks by staff who did not originally record the damage from the air presents certain challenges. The '[Using DMSM Tablet to Ground Check Aerial Survey Data](#)' document provides clarification.

Regardless of survey method, ground checking should always compliment data collection with real-time feedback to keep observers tuned and adjust future observations during operations.

Ground checks should be done where core attributes are unknown following any survey method. Ground checks should also be done where new damage types or agents are suspected and always when regulated pests are suspected. The extent of ground checking is subjective but should be thorough enough that the observer is confident the ground checks are representative of the feature of interest in terms of spatial position and core attributes; adjustments to any features should be made prior to data submission.

Submitting Bug Reports and Improvement Ideas

While actively working with the DMSM tablet application or DTT is the best time to make note of any problems or recommended improvements to these systems, check the [DMSM bug & fix tracker list](#) to make sure your issue has not already been recorded before notifying FHAAS of your ideas or concerns. To add items to the tracker, email [FHAAS's DMSM support team](#) with a detailed description of the feature request or bug report. Please include the required steps to replicate any buggy behavior. Support staff will work with you to make clarifications, if necessary, before adding your item to the list.

Mid-season Data Review and Edits

Most of the 'Post-Survey Data Processing Tasks' described below should occur throughout the survey season. GIS-savvy surveyors and GIS specialists should be routinely monitoring DMSM tablet application syncs, using [DMSM Desktop Tools User's Manual](#) to inspect and address issues with damage feature mapping and updating surveyed area boundaries as they become available. Recognizing that each state and region will develop the procedures that best meet their own circumstances, the FHP GIS Coordinators committee's '[Mid-season aerial detection survey editing guide](#)' offers valuable guidance



Post-Survey Data Processing

While GIS processing may be ongoing throughout the season, once survey data collection is completed, GIS specialists should make a comprehensive review of their entire state/regional dataset to ensure that their data is error-free as possible and ready for use in national reporting. While reviewing and editing mapped damage features is perhaps the primary task, there are other housekeeping activities that need to be performed after surveys are complete.

These include:

- Buffering the flightline and ground track data to create survey extent polygons. This is used to estimate the coverage area of the survey.
- Updating the estimated acres for point data. This is needed since acreage estimates can't be calculated directly from the geometry as is the case with polygon features.
- Flagging the data for public display and final reporting. Some states and regions have asked for mid-season sharing of data with the public. The PUBLISHED attribute can be used to facilitate this along with a notification to FHAAS that all review and post season tasks are complete.

Data Reviewer Checks

Data Reviewer is an ESRI extension that streamlines the data review and correction process. FHAAS has developed a set of Data Reviewer batch files with pre-defined data checks to flag DMSM data issues requiring review. These batch files are designed to work with DTT check-outs or flat-file extracts. Some data checks look for spatial relationships that do not necessarily violate any business rules, notably feature overlaps, but still should be inspected to determine if they require corrections or not. Others flag features with valid "placeholder" attribution that require review to properly finalize such as contested records or features attributed with a 90000 "Unknown" DCA codes. In addition to situations that may or may-not require corrections, there are other data checks for conditions where data absolutely must be fixed. For example, technical glitches or certain types of spatial edits that are necessary to meet national standards such as multi-part polygons or missing core attributes.

In addition to several batch files, the [Data Reviewer for DMSM and batch files](#) includes a comprehensive manual that provides an introduction to the Data Reviewer extension along with details on use of data validation batch files and options for correcting the problems flagged by those data checks. State and regional GIS coordinators should run all batch files and make all necessary corrections before certifying to FHAAS that they have finalized survey data for the current pest reporting year.

Buffering Flightlines and Ground Track Data to Generate Surveyed Areas

Surveyed area should always accompany detection survey data so users can differentiate surveyed areas with no detected damage from areas not surveyed. In DMSM survey areas are created from flightlines or ground tracks synced to the central database. Flightline/ground track line features are not editable. However, a buffer tool is available on the DMSM Desktop Tools toolbar that facilitates populating the FLIGHTPOLYS polygon feature class. After the initial buffers are created, traditional ArcMap editing tools can be used to edit the surveyed area polygons.

Contact [FHAAS](#) if edits to the flightline Collection Mode status (ground vs. aerial) or line geometry are needed for generating accurate surveyed areas.

Best practices include: removing ferries (where those did not include survey) and creating buffers for all relevant flightlines or ground tracks, removing slivers, and finally merging buffered flightline or ground track polygons by both aircraft and date. Importantly, do not merge all polygons into one single buffered area for the entire region. See '[Buffering Flightlines](#)' for suggested procedures.

Update ESTIMATED_POINT_ACRES

For many surveys, point features comprise a significant proportion of mapped damage. States/regions have the option to assign DAMAGE_POINT acreages that best represent the area impacted by these point observations. If states/regions do not populate the ESTIMATED_POINT_ACRES field in the OBSERVATIONS table, DMSM administrators will do so based on the default conversion for the NUMBER_OF_TREES_CODE.

The default conversion for the NUMBER_OF_TREES_CODE is detailed below. Variations are allowed to accommodate local standards but must be updated by the deadline for finalizing DMSM data, typically November 15th. If TREE_COUNT is used in lieu of NUMBER_OF_TREES, the same ranges in the standard table apply.

Table 3. Estimated Point Acres

Number of Trees Code	Number of Trees	Estimated Point Acres (Standard)
1	1	0.25
2	2 - 5	
3	6 - 15	1
4	16 - 30	
5	31 - 99	2

There is not a specialized tool in DTT for updating the estimated point acres. Traditional ArcMap table editing is required for this process. See '[Updating estimated point acres](#)' how-to document for details.

Update PUBLISHED Field

Some states and regions have asked for mid-season sharing of data with the public. The PUBLISHED attribute can be used to facilitate this along with a notification to FHAAS that survey data review and post season edits are complete.

The PUBLISHED field is a DAMAGE_POINT and DAMAGE_AREA attribute. While not visible on the DMSM tablet application, this field can be updated in DTT to identify which features can be shared publicly to cooperators mid-season via a publicly shared, view-only web map and to indicate when all data has been reviewed and finalized for FHAAS to use in year-end activities such as national reporting. While there are informal ways for states/regions to notify FHAAS that they have completed survey data cleanup, a preferred method is to set the PUBLISHED field for all their current survey year features to "Final".

By default, state or regional data is not viewable on the [<Current Year> Mid-season Draft and Final Aerial Survey Data Map](#).



Figure 11. Mid-season Draft and Final Aerial Survey Data Map Graphic

State and Regional GIS coordinators can choose to opt-in and share data with the public on this web map by updating the PUBLISHED field to 'Draft' or 'Final', See the code list below:

Table 4. Published code list

PUBLISHED code	Description	Mid-season Web Map rule
0 (or NULL)	No	Default state. Features are not included in the public facing web map
1	Mid-season draft	Data is still draft, but features are included in the public facing web map
2	Final	Data has been finalized and are included in the public facing web map

State/regional coordinators can do a save-as of the FHAAS web map to create their own customized web map or add as the service as layer to existing web maps they may already be managing. See the ['How-To Update the Published Field'](#) document for details on making updates to this field.



Submit Non-DMSM Data

Although DMSM is the platform standard for collecting and submitting data for inclusion in the National Insect & Disease Survey (IDS) database, some users may have data collected outside of the DMSM system and would still like to include it in the national database, these may be from a variety of ground or remotely sensed sources. As alternative approaches to data collection evolve over time and remote sensing tools are benchmarked for production, there will be an increasing amount of information entering the data stream and increased effort necessary to ensure compatibility and consistency. The template feature classes included in the [IDS Submission Template](#) package can be used to prepare data for submittal that meet core IDS database requirements.

The template includes:

- A File geodatabase with empty feature classes containing all required core fields
 - » DAMAGE_AREAS: for polygon features
 - » DAMAGE_POINTS: for point features
 - » SURVEYED_AREAS: survey boundary polygon features
- Spreadsheet that describes table schema, required fields, domains, and notes
- A python code snippet to help calculate the required feature IDs and a supporting document
- README support documentation

The criteria for inclusion in the national IDS database are:

1. The data represents geographic information about tree damage (points or polygons) from the current survey season. Data can be submitted after the reporting deadline, November 15th, however, it may not be included in national summaries for that survey year.
2. The data must include attributes described in the Standards for Forest Health Detection Survey Data listed at the beginning of this document. These required attributes are also detailed in the spreadsheet included in the IDS submission template.
3. Mapped damage derived from automated remote sensing/image processing or visual interpretation of imagery can be used to map tree damage. Until alternative survey methods have been properly benchmarked, the data submitted to IDS must be independently verified against independent information, such as ground observations, field reports, NAIP, or other high-resolution imagery collected on or around the damage event.
4. Survey boundary data, such as a buffered flight path, ground transect, or imagery extent, should accompany all submissions, including data derived from imagery, to distinguish areas without damage from those not surveyed at all.

Ideally, surveyors using non-DMSM tools to survey tree damage will pattern their database design based on this template. If a surveyor has reasons for deviating from the IDS core attribute standard, (for example, ground surveys that may include additional tree-specific damage types not included in the standard DAMAGE_TYPE code list) and want to submit those data for inclusion into IDS, they will need to develop crosswalks from their local code set to meet the national standards.

Appendix

Listing of all Links within the Handbook:

[A Guide to Conducting Aerial Sketchmapping Surveys](#)

[Aerial Survey Geographic Information System Handbook: *Sketchmaps to Digital Geographic Information*](#)

[Aerial Survey Standards](#)

[AGOL](#)

[AGOL DMSM home page](#)

[Buffering Flightlines](#)

[<Current Year> Mid-season Draft and Final Aerial Survey Data Map](#)

[<Current Year> View-Only web map](#)

[Damage causal agent code list](#)

[Damage type code list](#)

[Data Off-load procedure](#)

[Data Reviewer for DMSM and batch files](#)

[DCA Change Request form](#)

[DCA list](#)

[DCA Additions Revisions](#)

[Desktop Tools User Manual](#)

[Detection Surveys](#)

[DMSM AGOL home page](#)

[DMSM AGOL Applications page](#)

[DMSM bug & fix tracker list](#)

[DMSM Database Diagram](#)

[DMSM Desktop Tools \(DTT\)](#)

[DMSM Desktop Tools Data Validation](#)

[DMSM Desktop Tools User's Manual](#)

[DMSM Equipment Specifications and Recommendations](#)

[DMSM group home page](#)

[DMSM Making the Defoliation Call](#)

[DMSM Quick Key Host Group](#)

[DMSM Samsung Galaxy Tab setup](#)

[DMSM tablet application](#)

[DMSM tablet application user's manual](#)

[DMSM Tablet Data Recovery](#)

[DMSM training](#)

[DMSM Update Estimated Point Acres](#)

[DMSM Update Published Field](#)

[DMSM User Manual](#)

[DMSM: How to create a TPK](#)

[DTT toolbar: Quick Key tool add-in](#)

[Enhancing TPK Zoom Scales in DMSM](#)

[FHAAS](#)

[FHAAS's DMSM support team](#)

[Forwarn II](#)

[ForWarn II Data for ArcMap](#)

[ForWarn II Data in ArcPro](#)

[Guidance on Scan and Sketch data collection workflow](#)

[Host/host group code list](#)

[IDS Submission Template](#)

[Insect & Disease Survey \(IDS\) data submission template](#)

[managing annual insect and disease detection survey](#)

[Mid-season aerial detection survey editing guide](#)

[Quick Key !\[\]\(b634041e04d901fb11b06fb7a988fb9c_img.jpg\)](#)

[Update PUBLISHED field](#) 

[Updating estimated point acres](#)

[USDA Forest Service GTAC - ArcGIS Online
Access Requests](#)

[Using DMSM Tablet to Ground Check Aerial
Survey Data](#)