Aerial Survey Geographic Information System Handbook

Sketchmaps to Digital Geographic Information

November 2005

Forest Health Monitoring Program

State and Private Forestry
Forest Health Protection

Add 13030, adana tip moth, Rhyacionia adana

Add 14068, European elm scale, Gossyparia spuria

Add 14069, elm scurfy scale, Chionaspis americana

Change 15058, unknown, Prionoxystus robiniae to carpenterworm, Prionoxystus robiniae

Add 15083, cottonwood twig borer, Gypsonoma haimbachiana

Add 15084, southern pine sawyer, Monochamus titillator

Add 15085, banded ash borer, Neoclytus capraea

Add 15086, emerald ash borer, Agrilus planipennis

Add 16049, prairie tent caterpillar, Malacosoma lutescens

Add 16050, jack pine tip beetle, Conophthorus banksianae

Add 17021, jumping oak gall wasp, Neuroterus saltatorius

Change 21028, sudden oak death, Phytophthora spp. to Phytophthora ramorum

Add 22076, strumella canker, Strumella coryneoidea

Add 22077, phomopsis blight, Phomopsis juniperovora

Add 22078, fusarium canker of yellow poplar, Fusarium solani

Add 22079, sterile conk of maple and beech, Inonotus glomeratus

Add 22080, canker of spruce, Aleurodiscus spp.

Add 22081, birch conk, Piptoporus betulinus

Add 22082, canker, Discocainia treleasei

Add 24030, elm phloem necrosis, Mycoplasma

Add 26013, southern cone rust, Cronartium strobilinum

Add 80004, pinion pine mortality

November 2005 Database Requirements

Add section on Traditional v. Digital Aerial Sketchmapping

Add in the “Output” section information on acres summaries and general disclaimers

Add Requirements for submitting shapefiles

Map Projection Requirements: Projection and parameters information now shown using ArcGIS 9 terminology.

Change projection requirement to Datum NAD83

Add Figure 3: Table properties from the conversion of a properly formatted coverage to a shapefile using ArcGIS v.9 tools

Add Figure 4: Table properties formatted using D-ASM SketchTools v.2.6

Appendix A – Definitions of Items (Attributes) in Damage Coverages

Change dmg_type domain value 2 Mortality to 2 Mortality (Current)

Add dmg_type domain value 11 Previously Undocumented (Old) Mortality

Appendix D – Cooperating Agency Codes

Change

Add 41017, earthworm, Lumbricidae

Change 50012, wild fire to 30001, wild fire

Add

Table of Contents

Introduction

The purpose of this handbook is to guide the process of incorporating geographic information systems (GIS) into insect and disease aerial survey data storage, reporting, and analysis. The handbook discusses compiling and entering aerial survey sketchmaps into GIS, quality assurance/quality control (QA/QC) issues, and presents the GIS database standards, format, and coding schemes required for entering data into the national Forest Health Monitoring database.

It should be emphasized that a successful aerial survey program is a team effort involving, not only the sketchmappers, pilots, and ground support personnel, but also the people involved in compiling, digitizing, and moving the data into a digital database. Prior to the start of the aerial survey season, GIS personnel should meet with the aerial survey specialists and assist in the development of the aerial survey plan. GIS requirements for map types, coding schemes, definitions, and other data requirements should be identified before the survey is flown. It is hoped this document provides the link between the aerial survey, the Forest Health Monitoring Aerial Survey Standards and the national database, and identifies key GIS considerations that should be incorporated into the aerial survey. The use of GIS should streamline the process of getting the aerial survey sketchmap information into the hands of those who need and use it. These people range from program managers at the national level to land managers and field personnel.

The development of the handbook will be an ongoing process. As technology, policies, fieldwork procedures, aerial survey methods, and Forest Health Monitoring Standards change, the handbook will be revised. The Aerial Survey Standards Working Group hopes this handbook will be a useful reference for the people working with aerial survey data in GIS.

Traditional vs. Digital Aerial Sketchmapping

Traditional aerial sketchmapping is performed using paper maps. Advances in computer and

Getting Sketchmaps Ready for GIS

The goal is to use a map for aerial sketchmapping that is suitable for use both in the airplane and for digitizing. Choosing the map should be a coordinated effort between the aerial survey and GIS personnel. Compromises may have to be made, but the use of one map for both purposes will result in greater efficiency and eliminate errors that may arise in transferring data between maps of different scales or projections.

The schedule for mapping activities should be coordinated between the sketchmappers and the people doing the GIS work. Prior to the flying season, the aerial survey and GIS personnel should prepare a proposed schedule detailing when sketchmaps will be available for digitizing. The schedule should be realistic and reflect potential problems, such as bad weather that may delay the aerial survey.

Requirements for Sketchmaps

Information on and recommendations for base maps for aerial survey are presented in A Guide to Conducting Aerial Sketchmapping Surveys

- Areas covered by the aerial survey (see the discussion on Flown/Not Flown Areas, later in the guide) should be delineated on the sketchmap(s) or on another map(s) of similar scale. If a separate map is used, it should meet all of the above requirements.

Data Coding

Prior to the beginning of the aerial survey, there should be agreement between the sketchmapping and GIS personnel on the coding scheme to be used on the aerial survey maps. Requirements for coding may be different for different projects or aerial survey missions. Due to the difficulty of recording information on maps during flight, different coding schemes may be needed for recording the data on the sketchmaps from what is used in the GIS database. Coding schemes should take into account the national reporting efforts, and Region or local reporting requirements. There are, at this time, national standards in place for reporting mortality and defoliation that include standard attributes and coding schemes. These coding schemes are presented in the appendices to this guide.

A data dictionary should be developed for use both by the sketchmappers and the GIS personnel. The data dictionary should show each data element required and the characteristics of each element.

The characteristics of a data element are as follows:

- Name of data element
- Description of data element
- Type of data - Integer, decimal number, or alphanumeric character
- Size of field - Number of allowable characters
- Number of decimal places for numeric data
- Allowable cogable 1 TgreRrifT2 ber of dexme to be use(8.8(e)-.2kgreRrifT2 vor.2kgrpg of)8.57cE5(m)8

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- The final dataset should be clean (e.g., polygons should be closed, with no gaps or dangling line segments).
- A separate dataset of Flown/Not Flown areas should be created that covers the region of the sketchmaps (may be created by digitizing, scanning, buffering GPS data of flightlines, or other methods).

Data Processing

The dataset created by the conversion process is merely a set of points and polygons. Further processing is necessary to make it usable. The attributes for each point and polygon must be entered and attached to the appropriate feature. Two or more dataset may have to be combined to create a single one for a given project. Datasets may have to be projected into appropriate map projections. The end result of the processing should be a clean dataset that meets the units requirements for use of the aerial survey data. The dataset should also be able to be processed for incorporation into the national GIS aerial survey database. The final section of this document contains information on requirements for the national database.

There are numerous methods of entering attributes into GIS and associating them with the appropriate features. The method used should be based on the individual situation. The attributes are stored in the appropriate feature table in ArcInfo or a table in an Oracle database system. The attributes should be checked back against the sketchmaps to ensure accuracy. This can be accomplished by producing a 'check' map from the GIS showing features with attributes that can be directly compared to the sketchmaps.

If one aerial survey project produces several sketchmaps, the datasets for each map may be combined into one. The datasets to be combined must be in the same map projection. Adjacent maps should have been edgematched prior to converting the maps into digital form. However, additional editing may be necessary. Entering attributes into GIS can be performed either before or after maps have been combined into a single dataset.

Calculations, such as converting areas (usually expressed in meters) to acres, should be performed at the appropriate time, taking into account the processing steps to be performed. For example, calculating trees-per-acre should be performed with accurate acreage figures for the polygon to which the tree count applies. If a poylgon spans two or more map sheets, then the polygon segments should be joined before the trees-per-acre figure is calculated. This would also apply to situations in which the damage polygon may be divided during an overlay process such as overlaying damage polygons with county boundaries. Trees per acre should be calculated for the polygon before it is used in an overlay process. Standard conversion factors should be used throughout a project.

Each unit may have different requirements for using the aerial survey data. In producing maps and reports to meet these requirements, datasets may need to be projected into different map projections. ArcInfo provides the tools to achieve this.

The metadata should accompany the GIS dataset. The accuracy of the data is recorded in the metadata, and should serve as a reminder to anyone using the data as to the accuracy of the data.

Output

The only standard outputs from the aerial survey data are the requirements for FHM reporting and the national reporting efforts. Each year various maps and summaries are provided to the FHM Director and other cooperators. Each unit may have its own specific output requirements 14if0005 iyrlse(rv)-60-e accuraot

National GIS Database Requirements

A national GIS database for all aerial survey data has been established at the Forest Health Technology Enterprise Team (FHTET) in Fort Collins, Colorado. The purpose of this database is to provide a single source for all aerially detected insect, disease, and abiotic forest damage data to facilitate national and multi-regional level reporting of damage for both Forest Health Monitoring and Forest Health Protection. At this time, the National Aerial Survey Data Standards require only mortality and defoliation data be collected and reported. Many cooperators are collecting data on other damage types; for this reason, the national database has been configured to include those other damage types. The database will contain both current data and, as available, historic data. It is anticipated that, in the future, this database will be expanded to include insect and disease data collected by other means.

The database is built from polygon datasets developed by the Regions/Area and made available each year to the staff at FHTET. Data can be submitted as ArcInfo coverages or shapefiles. The following sections describe formatting requirements.

Datasets

- Overview Survey An overview survey is one during which all types of damage are mapped. This, the most common type of survey, normally takes weeks or months to complete, and covers an extensive area. All overview surveys will be delivered as a single polygon coverage or shapefile for each Region/Area, containing all damage data for that calendar year.

- Special SurveysSpecial surveys are flown to capture data on a single insect, disease or abiotic event, and are usually done at a time when the signature for that event is most apparent. These surveys frequently cover a smaller geographic area than an overview survey, and may infact overlap in area with the overview survey in the same year. Each special survey, or combinationof several special surveys for the same insect or pathogen, will be delivered as a separate coveage or shapefile in the same format as the overview survey.

- Flown/Not Flown Area Each overview and special survey dataset will be accompanied by a dataset delineating the area or areas surveyed. This dataset is needed to distinguish areas of no damage from areas for which there is no data.

Polygon Attribute Table For Damage Coverages

Figure 1 contains the polygon attribute table (PAT) format for aerial survey damage data collected during either overview or special surveys. Appendix A contains descriptions of each data item in the PAT. Example data and an example PAT for damage coverages is contained in Appendix C. The following should be noted about the PAT:

- The standard coding scheme allows for entering up to three aerial survey observations for any one polygon. Each observation is a unique combination of attrib

Polygon Attribute Table For Flown/Not Flown Coverages

Polygon Shapefiles

Data may also be submitted as shapefiles. Attribute naming conventions and coding schemes follow those described in the coverage section. In addition, any submitted shapefile must meet the following criteria:

- It must be a polygon shapefile.
- Each polygon must have a unique ID number.
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Figure 4: Table properties formatted using D-ASM SketchTools[1] v.2.6

Field Name	Type	Length	Precision	Scale
RPT_YR	Short Integer	4	4	0
SURVEY ID1,2,3	Text/String	6	0	0
DMG_TYPE1,2,3	Short Integer	4	4	0
SEVERITY1,2,3	Short Integer	4	4	0
PATTERN1,2,3	Short Integer	4	4	0
TPA1,2,3	Float	7	6	2
NO_TREES1,2,3	Long Integer	7	7	0
DCA1,2,3	Long Integer	5	5	0
HOST1,2,3	Short Integer	4	4	0
FOR_TYPE1,2,3	Short Integer	4	4	0
ACRES	Double	12	11	1
NOTES	Text/String	60	0	0

Field Name	Type	Length	Precision	Scale
RPT_YR	Short Integer	4	4	0
SURVEY ID1,2,3	Text/String	6	0	0
FLOWN1,2,3	Short Integer	4	4	0
AGENCY1,2,3	Text/String	10	0	0
SURVEYOR1,2,3	Text/String	30	0	0
BEGIN1,2,3	Date	8	0	0
END1,2,3	Date	8	0	0

Appendix A Definitions of Items (Attributes) in Damage Coverages

Attribute label: area perimeter coverage# coverage-id
Definition (description): Items generated by ArcInfo

Attribute label: survey_id1 survey_id2 survey_id3
Definition (description): Unique identifier for survey project
Source: USDA Forest Service, FHM Aerial Survey codes, GIS Handbook
Domain Value: -1 No data
User-defined numeric/alphanumeric code
Format Type: Character
Format Length: 6

Attribute label: rpt_yr
Definition (description): Year the survey was flown
Source: USDA Forest Service, FHM Aerial Survey codes, GIS Handbook
Domain Value: YYYY four digit year
Format Type: Integer
Format Length: 4

Attribute label: dmg_type1 dmg_type2 dmg_typ3
Definition (description): Damage type identification code
Source: USDA Forest Service, FHM Aerial Survey codes, GIS Handbook
Domain Value: -1 No Data
1 Defoliation
2 Mortality (Current Year)
3 Discoloration
4 Dieback
5 Topkill
6 Branch Breakage
7 Main Stem Broken/Uprooted
8 Branch Flagging
9 No Damage
10 Other Damage
11 Previously Undocumented (Old) Mortality
Format Type: Integer
Format Length: 2

Attribute label: severity1 severity2 severity3
Definition (description): Defoliation severity code
Source: USDA Forest Service, FHM Aerial Survey codes, GIS Handbook
Domain Value: -1 No Data
1 Low (Equal to or Less than 50 % defoliation)
2 High (More then 50 % defoliation)
Format Type: Integer
Format Length: 2

Attribute label: pattern1 pattern2 pattern3

Definition (description): Defoliation pattern code

Source USDA Forest Service, FHM Aerial Survey codes, GIS Handbook

Domain Value:
- -1 No Data
- 1 Host type or species is > 50 % and the damage is contiguous (relatively continuous)
- 2 Host type or species is > 50 % and damage is patchy (concentrated in discrete pockets or individual trees)
- 3 Host type or species < 50 % and damage is continuous
- 4 Host type or species < 50 % and damage is scattered

Format Type: Integer

Format Length: 2

Attribute label: tpa1 tpa2 tpa3

Attribute label: for_type1 for_type2 for_type3
Definition (description): Forest Type Code
Source: USDA Forest Service, EMAP FHM Manual (Eastern and Western) Appendix C
Domain Value: -1 No Data
0 to 9999 User-defined
Format Type: Integer
Format Length: 4

Attribute label: acres
Definition (description): Area in Acres of the Polygon
Source: USDA Forest Service, FHM Aerial Survey codes, GIS Handbook
Domain Value: -1 No Data
0 to 999999.9 User-defined
Format Type: Floating Point
Format Length: 12
Decimal Places: 1

Attribute label: notes
Definition (description): Notes (comments)
Format Type: Character
Format Length: 60

Appendix B Definitions of Items (Attributes) in Flown/Not Flown Coverages

Attribute label: area perimeter coverage# coverage-id
Definition (description): Items generated by ArcInfo

Attribute label: survey_id1 survey_id2 survey_id3
Definition (description): Unique identifier for survey project
Source: USDA Forest Service, FHM Aerial Survey codes, GIS Handbook
Domain Value: -1 No Data
User-defined numeric or alphanumeric code
Format Type: Character
Format Length 6

YYYYMMDD Date format
Format Type: Date
Format Length: 8

Attribute label: end1 end2 end3
Definition (description): Ending date for survey flown
Source USDA Forest Service, FHM Aerial Survey codes, GIS Handbook
Domain Value: -1 No Data
YYYYMMDD Date format
Format Type: Date
Format Length: 8

Attribute label: fl_days1 fl_days2 fl_days3
Definition (description): Number of days from beginning of survey to end of survey
Source: USDA Forest Service, FHM Aerial Survey codes, GIS Handbook
Domain Value: -1 No Data
1 to 999 User-defined
Format Type: Integer
Format Length: 3

Attribute label: purpose1 purpose2 purpose3
Definition (description): Purpose of aerial survey
Source: USDA Forest Service, FHM Aerial Survey codes, GIS Handbook
Format Type: Character
Format Length: 30

Attribute label: fl_notes
Definition (description): Notes (comments)
Format Type: Character
Format Length: 60

Appendix C Damage and Flown/Not Flown Polygon Examples

The following illustration and polygon attribute table (PAT) examples are provided to clarify various situations that occur both during a survey and while building attribute tables. Information is given for four hypothetical aerial surveys, which resulted in five flown/not flown polygons and seven damage polygons.

Polygon F2

PATTERN3	-1	-1	-1	2	-1	-1	-1	-1
TPA1	-1	150	-1	-1	-1	0.37	-1	0.5
TPA2	-1	-1	-1	-1	0.08	-1	0.08	2.5
TPA3	-1	-1	-1	-1	-1	-1	0.37	-1

NO_TREES1

PURPOSE2	SPB detection	Overview	-1	-1	Overview
PURPOSE3	-1	-1	-1	-1	-1
FL_NOTES					