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CETACEAN SURVEY LINE-TRANSECT DATA VERIFICATION AND MANAGEMENT

Alan R. Jackson

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Science Center

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INTRODUCTION

The Southwest Fisheries Science Center's cetacean survey line-transect data are collected under strict protocols and are subjected to comprehensive verification procedures. This is necessary to ensure the accuracy and reliability of these data that are used in the Center's assessments of dolphin populations of the eastern tropical Pacific Ocean. Despite automated data acquisition systems, precise instructions, technical training and due diligence, errors and inconsistencies may occur in the raw data. The top priority of data management is to prevent such errors from occurring and to identify and correct them when they do exist. The SWFSC's cetacean survey data are processed and managed with the primary goal of achieving the highest quality possible.

The purpose of this report is to describe the procedures and computer processes applied to cetacean survey line-transect data to ensure their accuracy and reliability.

BACKGROUND

Survey line transect data for dolphin population abundance estimates have been collected by the SWFSC since 1974 (Kinzey et al. 2000). Prior to 1982, surveys were conducted using existing data collection log sheets (*Marine Mammal Watch Daily Effort Record* and *Marine Mammal Sighting Record*) and data verification programs (MMEDIT*yr*) from the Tuna-Dolphin Observer Program. In 1982 specific research ship survey data forms (*Research Ship Marine Mammal Daily Effort Record* and *Research Ship Marine Mammal Sighting Record*) and verification programs (RVEDIT*yr*) were implemented, adapted from those of the Tuna-Dolphin Observer Program.

Prior to 1991, computers were not directly used in the data collection process[1]. Survey effort and sightings information was handwritten on data log sheets and later "keypunched" to computer files. The time of day was kept using a personal timepiece, and the ship's position was obtained from the Satellite Navigation System (SatNav) display by ship's personnel prompted by the survey scientists.

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[1] Computer Aided Sighting Technology (CAST) data were collected using computers during the 1986-90 surveys but were not included in the final survey data sets.

In 1991 a completely different survey data design and format were used in conjunction with the real time automated data acquisition computer program, CRUZ, connected to the ship's Global Positioning System (GPS). Along with the new data design, a new data verification computer program, CAMMEDT, was developed. These developments resulted in a marked improvement in the quality of the data. The implementation of CRUZ virtually eliminated data errors involving date/time and geographic position. It also eliminated the need to send handwritten data log sheets to be "keypunched". The data collection and verification programs (WinCruz and DasCheck, respectively) employed by the 1998 SPAM and 1999-2000 STAR surveys are refinements of CRUZ and CAMMEDT.

Survey line-transect data collected before 1982 are maintained with Tuna-Dolphin Observer Data (TVOD). The survey data, being in the TVOD format, are held in contemporaneous TVOD Mammal Effort (ME) and Mammal Sighting (MS) databases. The survey data collected between 1982 and 1990 are managed independently of TVOD in the Research Effort (RE) and Research Sighting (RS) databases. Pre-1991 data can be converted to the 1991-2000 format by MCONVERT and RCONVERT computer programs (Lee 1993)[2]. Survey data for 1986 through 1990 were permanently converted in March 2001, while pre-1986 data are maintained in the original formats and converted as needed for analysis.

The primary effort and sightings survey data are recorded by observers conducting a visual watch for marine mammals from the ship's flying bridge. Most observers have previous experience with ETP cetacean survey fieldwork. In preparation for their fieldwork, observers receive about 20 hours of technical training in a number of cetacean survey topics, including marine mammal abundance data collection, dolphin behavior data collection, use of the WinCruz computer program, school size estimation, and species identification.

Marine mammal observers record survey line-transect data in three places: (1) WinCruz data logging and automated data acquisition program, (2) the SWFSC *Marine Mammal Sighting Form* and (3) their individual daily logbooks commonly referred to as "green books". Data errors and inconsistencies can be introduced in a number of ways: handwritten entries transcribed incorrectly; data entry keystroke errors ("typos"); spoken information misunderstood by the data recorder; instructions or protocol not followed exactly; automated data acquisition system failure (system or program "crash").

All potential data collection problems must be anticipated and resolved. Data quality management practices are applied throughout the life span of the survey project and involve each aspect of it, from survey design and data systems testing, through observer training and precise operational guidelines, to data verification procedures and feedback from principal investigators and other end-users of the data.

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[2] These two computer programs were substantially improved by Scott Keagy in 1995 and 1996. A brief explanation of these changes is provided in a comment section at the top of the program source code (MCONVERT.for and RCONVERT.for).

DATA COLLECTION PROCEDURES

Marine mammal observers rotate through three watch positions: port binocular, data recorder and starboard binocular[3]. (On some surveys, secondary "tracker" or "independent observer" positions may be used for comparison with the sightings made by the primary team.) At least one cetacean identification specialist with substantial experience in the survey area and methods is on watch at all times and directs the observer team operations as well as confirms the species/stock identification(s) assigned to each sighting. The data recorder is responsible for entering all effort, sighting and environmental data into WinCruz and for the initial handwritten entries to the *Marine Mammal Sighting Form*. The data recorder is typically the person who communicates with the ship's bridge during searching operations with a handheld radio. The ship's bridge watch logs environmental data every hour and is usually the source of information for the wind, wave and swell data entered into WinCruz.

The data recorder enters effort, sightings and environmental data into the program WinCruz[4] running on a laptop computer located on the ship's flying bridge. The computer on the flying bridge is linked to the ship's GPS to record time and position data for every "event" such as a sighting or change in effort parameters. Some data are coded to allow for easier entry and storage. The codes are defined in "code tables" that are available to observers for reference. These coded data include observer identification, species/stock identification, sighting cues and sighting methods.

WinCruz is used to monitor each different type of survey event. Each new event is represented by a new record in the database. Keyboard function keys are used to record new events. Data are entered with the aid of a "dialog box" for each event. WinCruz also automatically acquires time and position data every 10 minutes if no new event is entered. (Appendix 1 provides the name and a brief description of each type of event and associated data fields.) WinCruz tests entered data according to preset ranges of values, prompting the user to confirm a value that is outside a range.

WinCruz produces two data files: Das*XXXX.mdd* and Bak*XXXX.mdd* where *XXXX* in the filename is the 24-hour clock time at which WinCruz was started for the day, *m* is hexadecimal month and *dd* is decimal day, e.g., Das0655.B07 for 6:55 a.m. on November 7th. The "Das" file contains the final effort and sightings data output from WinCruz while the "Bak" file contains preliminary data that can be used in the event the Das file is lost.

The *Marine Mammal Sighting Form* (Appendix 2) is designed to supplement and duplicate some of the data recorded by WinCruz. Date, time, sighting number, angle and distance to the target are handwritten by the recorder as a "backup" to the Das computer

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[3] Although Kinzey et al. (2000) provides a general description of the SWFSC's line-transect data collection procedures, a more practical description can be found in each survey's Marine Mammal Observer Manual, e.g., Olson (2000).

[4] Technical aspects of WinCruz are given in the SWFSC working document "WINCRUZ: Windows Real Time Sighting-Effort Event Logger" (WinCruz.doc).

file, while other information on taxonomic identification (including a sketch showing observed identifying characteristics) and behavior is unique to the form. The *Marine Mammal Sighting Form* is used to document each sighting, support the species/stock identification and describe other features of interest associated with the sighting.

Although the recorder initiates the *Marine Mammal Sighting Form* by entering the species/stock identification, time, angle and distance into the appropriate fields, the observer who first sighted the animal(s) is generally responsible for completing the rest of the form. On the back of the form are questions regarding dolphin behavior. Either the observer who made the sighting or the one who got the best view of the animals answers these questions. The observer circles the best answer provided on the form for each question.

The principal marine mammal data collected are the species/stock identifications and group (school) size estimates. Ideally, the ship stays with a cetacean school long enough for all on-watch observers to see all the stocks present and make their best possible estimates of the number of individual animals present. The observers collaborate in determining the identity of the species/stock(s) represented (see Appendix 3 for sighting categories). The observer team leader, in consultation with the others, makes the final determination of the appropriate taxonomic level to record for the sighting. If the team is not able to conclusively determine a species/stock identity but is convinced of the likelihood of the identity, then two identifications are recorded: one at a higher taxonomic level, e.g., "unidentified dolphin" and another "probable" identification at a lower taxonomic level, e.g., "*Tursiops truncatus* (bottlenose dolphin)".

Each observer maintains a logbook, used primarily to record estimates of the number of individuals and species/stock composition for each school seen by that observer (Appendix 4). The observer makes three estimates of school size (best, high and low) for each sighting. The high estimate is the number that the observer confidently feels is not exceeded by the number of individuals in the school; similarly a low estimate is the number for which the observer is confident that the school size equals or exceeds. Estimates of school size and percent taxonomic composition (for mixed species/stock schools) are made independently by each observer and entered into his logbook without discussion among observers of one another's estimates at any time. The use of individual logbooks prevents observers from being inadvertently influenced by the school size and species composition estimates of others. The cruise leader collects the logbooks at the end of each day.

DATA EDITING AND BACKUP PROCEDURES AT SEA

The survey cruise leader is responsible for the data management tasks at sea[5]. When marine mammal watch effort ends for the day, the WinCruz data (all Das and Bak files) are copied (backed up) to two different diskettes. These files are never edited and

[5] Cruise leader responsibilities and tasks are described in the "Cruise Leader's Manual", a collection of directives, reports and other resources specific to each year's survey and vessel.

serve as a backup source of raw, unedited survey data if ever needed. The daily Das file(s) is copied to the cruise leader's computer for editing. If there is more than one Das file for the day, the files are combined chronologically into one file. The file to be edited is named DasAll.*mdd*, and a listing of the day's Das data is printed.

The printed Das data listing is checked against the sighting forms. The observers do this immediately following the end of effort each day in order to confirm such basics as species codes and sighting numbers. Any need for editing is clearly noted on the listing. At this point, sightings may be renumbered or combined; however, the identification specialists ensure that each sighting number is accounted for (voided numbers are acceptable), and that the sighting numbers and species codes on the printout match those on the sighting forms for each sighting. Each sighting should have at least a species code, an angle and a distance.

The cruise leader checks the data listing for completeness. All comments about problems that occurred during the day are read and the problems resolved. All editing changes are written on the printout so that there is a record of the changes made to the original data files. The changes are then made to the DasAll file using a plain ASCII text editor. The cruise leader adds the school size estimates and species compositions for each sighting (on the "A" event record) directly from the observers' logbooks into the DasAll file.

As a final data verification step, the DasAll file is checked electronically using the computer program DasCheck. DasCheck performs a comprehensive assessment of the data for possible errors (see the discussion of DasCheck in the next section). The cruise leader investigates and resolves these errors and makes corrections (edits) to the DasAll file. Any edits made by the cruise leader (apart from school size estimates) are noted by hand on the printed data listing. The cruise leader also notes any unusual, yet valid, situations on the data listing. The insertion of a "C" or comment event in the DasAll file briefly confirming the validity of the data in question is sometimes done. (When the data are later re-edited at the laboratory, the editor keeps the original data listings at hand in order to review edits made by the cruise leader.)

The edited DasAll file is copied to each of two data diskettes that are kept in a secure place. A third copy of the DasAll file remains on the cruise leader's computer. These editing and data protection tasks are completed as soon as possible after the end of the day's searching effort. If there are discrepancies, or records are incomplete, observers are questioned while their memories are still fresh.

Photocopies of all completed sighting forms are made. The original sighting forms, data listings and a set of diskettes containing the Das, Bak and DasAll files are returned to the laboratory by scientific personnel disembarking at a port call or at the end of the survey cruise. The original sighting forms are removed from the ship at port calls only if a set of photocopies is safely stored aboard ship.

DATA EDITING AND MAINTENANCE AT THE LABORATORY

Data and Documents Received and Inventoried

Either at the end of the survey or, when possible, during port calls, the daily data files (on diskette), original *Marine Mammal Sighting Forms*, raw Das data listings and daily DasCheck reports are delivered to the project's data manager. The data include all Bak*XXXX.mdd*, Das*XXXX.mdd* and DasAll.*mdd* files. The observers' logbooks are delivered to the data manager at the end of the survey. The original sighting forms and Das data listings are placed in labeled three-ring binders and stored in a locked cabinet. The logbooks and the original daily Das and Bak files on diskettes are also stored in this cabinet.

The DasAll files are checked against the Das*XXXX.mdd* files to ensure that they are complete, i.e., all the data for each day are included in the corresponding DasAll file. The DasAll files are concatenated chronologically to create a single cruise data file that is given a unique name consisting of the survey acronym and cruise number with the file extension of "das", e.g., STAR1613.das. Each day of the cruise must be represented in this file. If days are missing, weekly cruise reports are checked to determine the reason for the missing day. Explanatory comment records ("C" events) are inserted for port days and bad weather days for which no survey data were collected and no record previously existed in the Das file.

Species/Stock Verification, Probable Species and "Tracker" Sightings

Each *Marine Mammal Sighting Form* is examined to verify the species/stock identification and assigned code. For stocks unfamiliar to the reviewer, an expert is consulted. A red check mark is placed next to the stock code to indicate the identification has been verified. The verification process is described in Leatherwood (1978). Although the Leatherwood guidelines were written specifically for evaluating sighting records and verifying cetacean identifications for the Tuna-Dolphin Observer Program, the basic process is applied to survey data. Leatherwood stresses the importance of "accurate descriptions and sketches based on good observation conditions, close approach (<1 mile without binoculars, <2 miles with), and several good views of diagnostic characters...."

"Probable" species/stock identifications are identified and underlined in red. Probable identifications are added to the Das file by inserting "?" event records. For multi-species/stock sightings with one or more component stock(s) not receiving a probable identification, those stock identifications are also put on the "?" event record. The species/stock code(s) assigned to each sighting and written on the *Sighting Form* is compared to the Das file to ensure the cruise leader entered it correctly.

Logbook entries are compared to the DasAll data in order to catch any transcription errors such as transposition of values, omission of entries, etc., for school

size and species composition data. The computer program ObsReport produces a listing of school size and species composition data by cruise and observer to facilitate this.

"Tracker" effort and sightings data must be prepared separately prior to being collated with standard DasAll data. To date only one survey cruise (SPAM1611, 1998 R/V *Endeavor*) has collected tracker sighting data. A description of how tracker data is processed and merged with the regular Das data is described in Appendix 5.

DasCheck Data Verification Process

The sheer volume of data (approximately 30,000 records per cruise) precludes a record-by-record, field-by-field manual review of the data for accuracy. Instead, a comprehensive set of error checks is performed by the computer program DasCheck[6]. There are two types of error checks: (1) range/blank check that identifies ("flags") a value that should not be blank or that falls outside a specified range; and (2) logical check that flags a value that is questionable based on the value(s) of one or more related variables. An example of a range check is a test that the numeric value for the variable *Month* is between 1 and 12. An example of a logical check is a test that if *Best* and *High* school sizes are both not blank, then the value for *High* school size must be greater than the value of *Best* school size. (Appendix 6 lists the Das variables, tested ranges of values and logical checks.)

DasCheck produces a report detailing possible errors in the data file. (See Appendix 7 for an example of the report.) The report gives the record number, a listing of the data, an error message number, a narrative description of the type of problem and the name of variable and value in question. A reviewer, or data editor, investigates each error message in the report. The assumption is that the data are valid unless there is convincing evidence otherwise. That is, a value is not changed unless the new value is supported by related evidence. Corrections are also made to the original sighting forms in red ink and initialed and dated. Some errors cannot be corrected due to lack of contextual information, and these data are deleted.

After editing the data based on the DasCheck report, DasCheck is re-run on the data. Again, each and every error message in the new report is investigated and data are edited. This process is repeated until no further errors are found in the data. An evaluation of the types of errors detected by DasCheck can determine areas for improvement in observer training.

Database Maintenance and Archive

After being edited, the survey line-transect data are stored on-line on a file server on the SWFSC's private local area network (LAN). This single location ensures that

[6] DasCheck, based on the data verification programs of the Center's Porpoise Data Management System (1979-1990) described by Oliver (1991), was originally implemented as CAMMEDT, a DOS-based application written by Ken Wallace in 1992. Katie Cramer made numerous improvements to this program in 1998, and in 1999 John Brandon converted it to a Windows application.

researchers always have access to the latest version of the data. Access to these data is restricted to authorized principal users, the data manager and the LAN system administrator. The users have "read-only" access privileges to the account holding these data, that is, they may copy these files to another device, but they cannot delete, modify or overwrite them on the file server. The data manager has full privileges. The survey data are also on a removable data storage device that is stored offsite, as well as in a password-protected MS System Backup File (.qic) on the data manager's local hard disk. All or some of these files are also temporarily stored on the data manager's desktop PC that is running a password protected operating system.

Despite comprehensive editing, some obscure errors may remain in the data. Researchers may find these errors and are encouraged to report them to the data manager. These errors and corrections are listed in the spreadsheet Updates.xls which provides a record of what was changed and when.

ACKNOWLEDGEMENTS

Ultimately, the quality of the survey line transect data depends on the performance of the marine mammal observers themselves. The SWFSC is fortunate to be able to count on the service of a corps of able, experienced and dedicated observers. Some of these observers have served in this capacity for many years and are among the world's most experienced describers of cetacean physical characteristics and natural behavior.

The author, who has not participated in survey fieldwork since 1988, benefited from Doug Kinzey and Paula Olson's firsthand accounts of recent field operations. Tim Gerrodette reviewed this manuscript for accuracy and added further detail to the role of the cruise leader. Robert Holland is the computer specialist responsible for maintaining WinCruz.

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Appendix 1. DasAll events and associated data fields.

All event records, except events "1"-"8" and "?", begin with these six data fields:
Sequence (columns 1-3)
Event (columns 4-4)
On Effort (columns 5-5)
Time (columns 6-11)
Date (columns 13-18)
Position (columns 20-39),
followed by up to eight more data fields (depending on the Event code in column 4) with the following locations in the record:

Field 1 (columns 41-44)
Field 2 (columns 46-49)
Field 3 (columns 51-54)
Field 4 (columns 56-59)
Field 5 (columns 61-64)
Field 6 (columns 66-69)
Field 7 (columns 71-74)
Field 8 (columns 76-79)

Event "B", begin effort for the day.

Field 1: **Cruise Number**, the unique number assigned to the cruise.
Field 2: **Mode**, passing or closing on sightings.
Field 3: **Dev from GMT**, the difference in hours between local time and GMT.
Field 4: **Echo Sounder**, monitors use of EQ50 or similar echo sounding gear.

Event "R" Resume effort in the study area. (No other data fields accompany this event.)

Event "r" Resume effort outside the study area. (No other data fields accompany this event.)

Event "E" End on-effort searching mode. (No other data fields accompany this event.)

Event "P" Observer Positions.

Field 1: **Left Bino**, identity of the observer on the port binoculars.
Field 2: **Rec**, identity of the observer acting as data recorder.
Field 3: **Right Bino**, identity of the observer on the starboard binoculars.
Field 4: **Ind Obs**, identity of the observer acting as independent observer.

Event "V" Sea state viewing conditions.

Field 1: **Beaufort**, beaufort sea state.
Field 2: **Swell Ht**, height of predominant swell in feet.
Field 3: **Swell Dir**, compass direction of predominant swell.
Field 4: **SSurf Temp**, sea surface temperature, normally left blank.
Field 5: **Wind Speed**, true wind speed in knots.

Appendix 1. DasAll events and associated data fields (continued).

Event "N" Navigation information.

Field 1: **Course**, direction the ship is moving, course made true.
Field 2: **Speed**, ship's speed over ground.

Event "W" Weather information.

Field 1: **Fog or Rain**, indication of the presence of rain, fog, or haze.
Field 2: **Horiz Sun**, horizontal sun angle.
Field 3: **Vert Sun**, vertical sun angle.
Field 4: **Wind Dir**, wind direction in degrees, relative to true North.
Field 5: **Visibility**, distance in nautical miles at which a dolphin could be seen surfacing with the water (not sky) as background.

Events "S" or "K" Marine mammal sighting.

Field 1: **Sight**, the unique sighting number.
Field 2: **Detec By**, identity of the observer who first detected the cue leading to the sighting.
Field 3: **Sighting Q**, type of cue that led to the sighting.
Field 4: **Sighting Method**, the method by which the school was detected.
Field 5: **Bearing**, the horizontal angle between the trackline and sighting in degrees.
Field 6: **Reticle**, the number of eyepiece reticle marks between the horizon and sighting in the binocular field of view.
Field 7: **Distance**, the radial distance to the sighting in nautical miles.
Field 8: **MM Heading**, the course the school is moving relative to the vessel's trackline.
Field 9: **MM Speed**, estimated speed of the school in knots.

Event "A" Auxiliary sighting information.

Field 1: **Sight**, the unique sighting number (same as in Event S).
Field 2: (This field not used.)
Field 3: **Photos**, indication of whether photographs were taken of the school.
Field 4: **Birds**, indication of whether birds were present with the school.
Field 5: **Sp1 Code**, the first of up to four species/stock components of the school.
Field 6: **Sp2 Code**, the second of up to four species/stock components of the school.
Field 7: **Sp3 Code**, the third of up to four species/stock components of the school.
Field 8: **Sp4 Code**, the fourth of four species/stock components of the school.

Events "s" or "k" Resighting information.

Field 1: **Sight**, the sighting number assigned to the original sighting.
Field 2: **Bearing**, the bearing to the sighting in degrees.
Field 3: **Reticle**, the number of eyepiece reticle marks between the horizon and sighting in the binocular field of view.
Field 4: **Distance**, the radial distance to the sighting in nautical miles.

Appendix 1. DasAll events and associated data fields (continued).

Field 5: **Course**, the course the school is moving relative to the vessel's trackline.

Event "t" Turtle sighting.
- Field 1: **TDetec By**, the identity of the observer that made the sighting.
- Field 2: **Sp Code**, the turtle species.
- Field 3: **TBearing**, the bearing in degrees to the turtle.
- Field 4: **TDistance**, the distance in nautical miles to the turtle.
- Field 5: **Num Turtles**, the number of individual turtles.
- Field 6: **Assoc JFR**, the type of associated flotsam or debris.
- Field 7: **TReticle**, the number of eyepiece reticle marks between the horizon and sighting in the binocular field of view.
- Field 8: **Maturity**, observer estimate of whether the turtle is an adult or juvenile.
- Field 9: **Captured**, whether the turtle was captured.

Event "F" Fishing vessel sighting.
- Field 1: **Boat Detec By**, the observer who made the sighting.
- Field 2: **BBearing**, the bearing to fishing vessel.
- Field 3: **Distance**, the distance in nautical miles to the vessel.
- Field 4: **Reticle**, the number of eyepiece reticle marks between the horizon and sighting in the binocular field of view.

Event "C" Comment. (Comments are not confined to discrete data fields.)

Event "Q" Tracking team positions (used during special projects).
- Field 1: **Obs A**, the identity of tracker team member number 1.
- Field 2: **Obs B**, the identity of tracker team member number 2.
- Field 3: **Obs C**, the identity of tracker team member number 3.
- Field 4: **Obs D**, the identity of tracker team member number 4.

Event "*" Automatic position recorded every 10 minutes if no intervening event is entered. (No other data fields accompany this event.)

Event "#" Deleted event. Event was deleted from the event buffer. (No other data fields accompany this event.)

Event "?" Probable species/stock identity (used in conjunction with "A" events.)
- Field 1: **Sight**, the unique sighting number (same as in Event S).
- Field 2: (This field not used.)
- Field 3: (This field not used.)
- Field 4: (This field not used.)
- Field 5: **Sp1 Code**, the first of four probable species/stock components of the school.
- Field 6: **Sp2 Code**, the second of four probable species/stock components of the school.

Appendix 1. DasAll events and associated data fields (continued).

Field 7: **Sp3 Code**, the third of four probable species/stock components of the school.
Field 8: **Sp4 Code**, the fourth probable species/stock components of the school.

Events "1"-"8" Observer estimates of school size and species/stock composition.
Field 1: **Obs Code**, identity of the observer providing estimates.
Field 2: **Bst Est Schl**, observer's best estimate of school size.
Field 3: **Hi Est Schl**, observer's highest estimate of school size.
Field 4: **Lo Est Schl**, observer's lowest estimate of school size.
Field 5: **Sp1 Percent**, observer's estimate of the percentage of the school represented by the first species/stock component.
Field 6: **Sp2 Percent**, observer's estimate of the percentage of the school represented by the second species/stock component.
Field 7: **Sp3 Percent**, observer's estimate of the percentage of the school represented by the third species/stock component.
Field 8: **Sp4 Percent**, observer's estimate of the percentage of the school represented by the fourth species/stock component.

Appendix 2A. SWFSC Marine Mammal Sighting Form (front).

SWFSC Marine Mammal Sighting Form

NOTES: w/ ANGLE

Date 99 08 15 (Y Y M M D D) Cruise # 1613 Sighting # 1224 — 021

Time 1232 Effort (ON) OFF Observer # 126 — 0.1

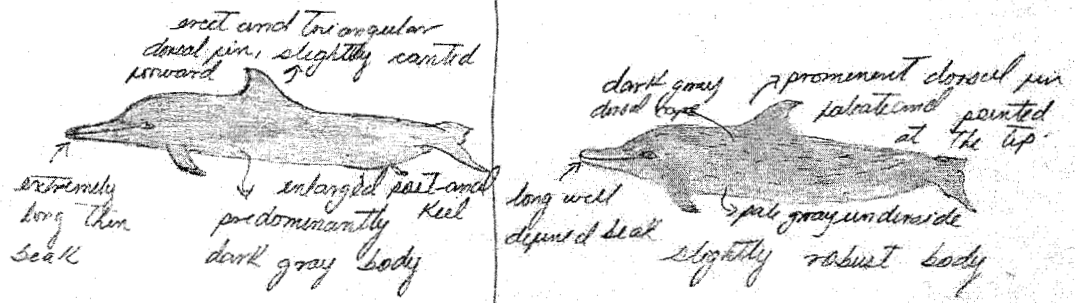
SPECIES DETERMINATION

	CODES	
1. S longirostris orientalis	010	✓
2. S attenuata attenuata	002	/
3.		
4.		

ASSOCIATED ANIMALS: List ID and number of other species near the sighting.

BIRDS: 66 BOBR 17 TESO 1 JASP 1 FRMA (juv) 2 NOBR 3 SHWW — 3 BARF

DIAGNOSTIC FEATURES: Describe and sketch the shape, size and markings of the species identified.



#092: Lightly spotted adults

BEHAVIOR: Describe the aggregations, movements, blows, etc. of the animals.

Mixed school of spinners and spotted dolphins seen at 4.3 nm initially, some splashes under bird flock. Until fairly close animals did not seen to react to vessel, some tuna seen among them jumping. at about 1.3 nm the school was moving at moderate speed. Some animals headed towards the bow and rode for few minutes, Some calves seen on the group.

School Movement: Initial Speed 3.0 Direction relative to bow 270 Closest Distance BOW

Calibration Y (N) Bow Riding (Y) N Biopsy (Y) N Photographs (Y) N

990815-02 to 08 → spinner only TDA99-07: 1-17

NOAA FORM 88-208 (9/94)

★ U.S. GPO: 1997-581-635/40256

Appendix 2B. SWFSC Marine Mammal Sighting Form (back).

#1224 **BEHAVIORAL OBSERVATIONS**

Closest distance between dolphins and vessel: bow

In your estimation, when first observed,
were the animals already reacting to the research vessel? Y (N) U O

I. Group Behavior

Behavior when first observed (circle all that apply):

fast traveling | (moderate traveling) | slow traveling | milling | (associated swimming) | unknown | other

Did the behavior change during observation? (Y) N U O

If the behavior changed, what did the behavior change to (circle all that apply)?

fast traveling | (moderate traveling) | slow traveling | milling | associated swimming | unknown | other

II. School Shape

Were individuals spaced: tight (loose) unknown other

If loose, were the individuals: uniform (clumped) unknown other

III. School Composition

Calves present? (Y) N U O

IV. Reaction to the Vessel

Approach the boat? (Y) N U O

Bow ride? (Y) N U O

Run from the boat? Y (N) U O

Low swimming? (Y) N U O

Did the school split? Y (N) U O

If yes, did the subgroups move off in different directions? Y N U O

If yes, and it's a mixed school, is the subgroup composition: mixed single species unknown other

V. In your estimation, relative to the research vessel, was this school:

evasive | (non-evasive) | both | unknown | other

Key: Y = yes N = no U = unknown/cannot be determined O = other, please explain

Appendix 3. SWFSC marine mammal and sea turtle sighting category codes (July 2000).

Code	Scientific Name	Standard Common Name
001	*Mesoplodon peruvianus*	Pygmy beaked whale
002	*Stenella attenuata* (offshore)	Offshore pantropical spotted dolphin
003	*Stenella longirostris* (unid. subsp.)	Unidentified spinner dolphin
004	*Stenella clymene*	Clymene dolphin
005	*Delphinus* sp.	Unidentified common dolphin
006	*Stenella attenuata graffmani*	Coastal spotted dolphin
007	*Sotalia fluviatilis*	Tucuxi
008	*Orcaella brevirostris*	Irrawaddy dolphin
009	*Australophocaena dioptrica*	Spectacled porpoise
010	*Stenella longirostris orientalis*	Eastern spinner dolphin
011	*Stenella longirostris* (whitebelly)	Whitebelly spinner dolphin
012	*Lagenorhynchus albirostris*	White-beaked dolphin
013	*Stenella coeruleoalba*	Striped dolphin
014	*Lagenorhynchus acutus*	Atlantic white-sided dolphin
015	*Steno bredanensis*	Rough-toothed dolphin
016	*Delphinus capensis*	Baja neritic common dolphin
017	*Delphinus delphis*	Offshore common dolphin
018	*Tursiops truncatus*	Bottlenose dolphin
019	*Cephalorhynchus heavisidii*	Heaviside's dolphin
020	*Cephalorhynchus hectori*	Hector's dolphin
021	*Grampus griseus*	Risso's dolphin
022	*Lagenorhynchus obliquidens*	Pacific white-sided dolphin
023	*Lagenorhynchus australis*	Peale's dolphin
024	*Lagenorhynchus cruciger*	Hourglass dolphin
025	*Lagenorhynchus obscurus*	Dusky dolphin
026	*Lagenodelphis hosei*	Fraser's dolphin
027	*Lissodelphis borealis*	Northern right whale dolphin
028	*Lissodelphis peronii*	Southern right whale dolphin
029	*Cephalorhynchus eutropia*	Black dolphin
030	*Cephalorhynchus commersonii*	Commerson's dolphin
031	*Peponocephala electra*	Melon-headed whale
032	*Feresa attenuata*	Pygmy killer whale
033	*Pseudorca crassidens*	False killer whale
034	*Globicephala* sp.	Unidentified pilot whale
035	*Globicephala melas*	Long-finned pilot whale
036	*Globicephala macrorhynchus*	Short-finned pilot whale
037	*Orcinus orca*	Killer whale
038	*Sousa chinensis*	Indo-Pacific hump-backed dolphin
039	*Sousa teuszii*	Atlantic hump-backed dolphin
040	*Phocoena phocoena*	Harbor porpoise
041	*Phocoena sinus*	Vaquita
042	*Phocoena spinipinnis*	Burmeister's porpoise
043	*Neophocaena phocaenoides*	Black finless porpoise
044	*Phocoenoides dalli*	Dall's porpoise
045	*Delphinapterus leucas*	White whale
046	*Physeter macrocephalus*	Sperm whale
047	*Kogia breviceps*	Pygmy sperm whale
048	*Kogia sima*	Dwarf sperm whale
049	Ziphiid whale	Unidentified beaked whale
050	*Hyperoodon planifrons*	Southern bottlenose whale

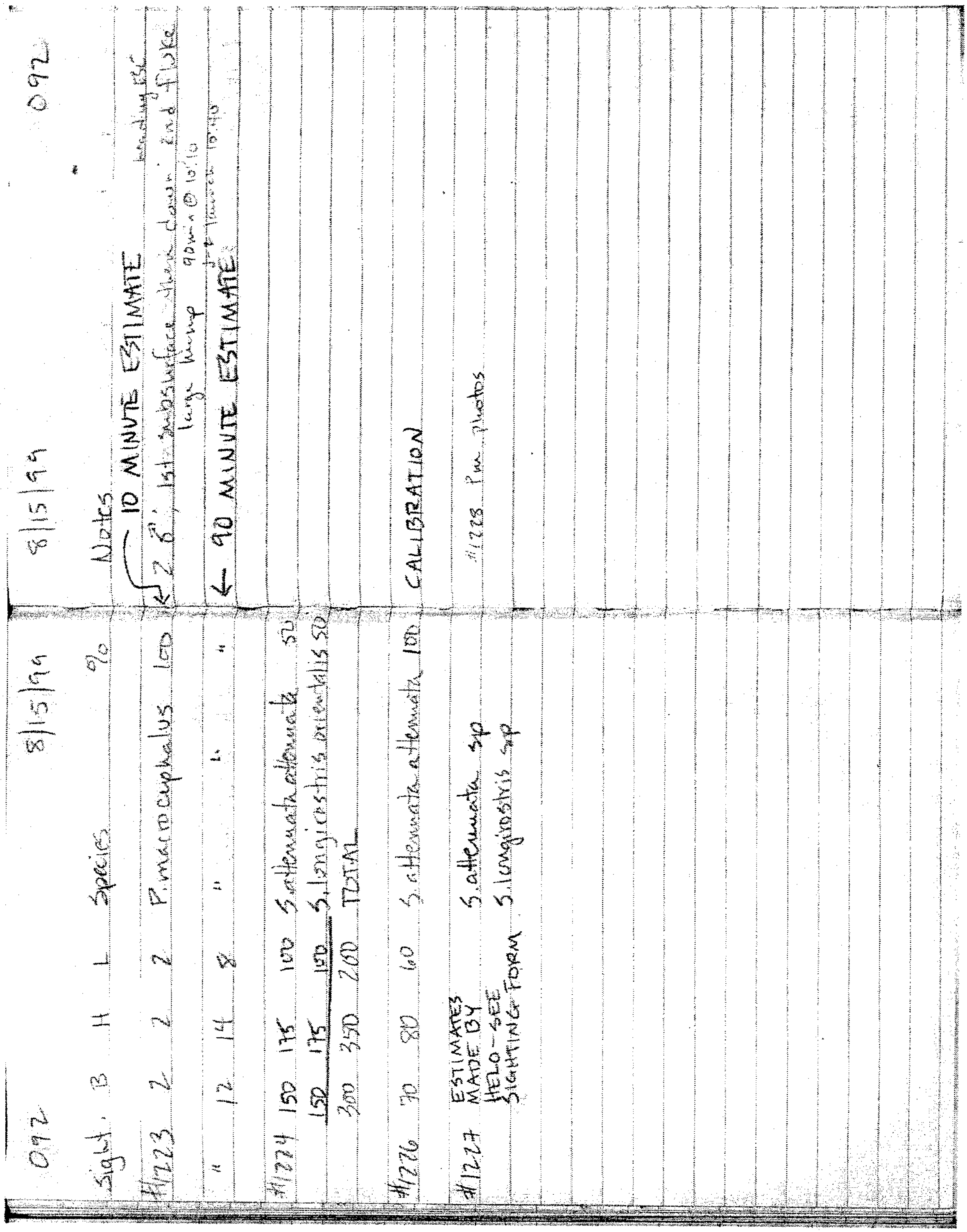
Appendix 3. SWFSC sighting category codes (continued).

Code	Scientific Name	Standard Common Name
051	*Mesoplodon* sp.	Unidentified Mesoplodon
052	*Mesoplodon carlhubbsi*	Hubb's beaked whale
053	*Mesoplodon hectori*	Hector's beaked whale
054	*Mesoplodon bowdoini*	Andrew's beaked whale
055	*Mesoplodon europaeus*	Gervais' beaked whale
056	*Mesoplodon bidens*	Sowerby's beaked whale
057	*Mesoplodon ginkgodens*	Ginkgo-toothed beaked whale
058	*Mesoplodon grayi*	Gray's beaked whale
059	*Mesoplodon densirostris*	Blaineville's beaked whale
060	*Mesoplodon layardii*	Strap-toothed whale
061	*Ziphius cavirostris*	Cuvier's beaked whale
062	*Berardius arnuxii*	Arnoux's beaked whale
063	*Berardius bairdii*	Baird's beaked whale
064	*Tasmacetus shepherdi*	Shepherd's beaked whale
065	*Mesoplodon pacificus*	Longman's beaked whale
066	*Balaena glacialis japonica*	North Pacific right whale
067	*Balaena mysticetus*	Bowhead whale
068	*Caperea marginata*	Pygmy right whale
069	*Eschrichtius robustus*	Gray whale
070	*Balaenoptera* sp.	Unidentified rorqual
071	*Balaenoptera acutorostrata*	Common minke whale
072	*Balaenoptera edeni*	Bryde's whale
073	*Balaenoptera borealis*	Sei whale
074	*Balaenoptera physalus*	Fin whale
075	*Balaenoptera musculus*	Blue whale
076	*Megaptera novaeangliae*	Humpback whale
077		Unidentified dolphin or porpoise
078		Unidentified small whale
079		Unidentified large whale
080	*Kogia* sp.	Unidentified *Kogia* - dwarf or pygmy sperm whale
081	*Mesoplodon stejnegeri*	Steinger's beaked whale
082	*Mesoplodon mirus*	True's Beaked Whale
083	*Mesoplodon* sp. A	Unnamed beaked whale
084	*Hyperoodon ampullatus*	Northern Bottlenose
085	*Monodon monoceros*	Narwhal
086	*Balaena glacialis australis*	Southern right whale
087	*Pontoporia blainvillei*	Franciscana
088	*Stenella longirostris centroamericana*	Central American spinner dolphin
089	*Stenella attenuata/plagidon*	Unidentified spotted dolphin in Atlantic
090	*Stenella attenuata* (unid. subsp.)	Unidentified pantropical spotted dolphin
091	*Stenella frontalis*	Atlantic spotted dolphin
092	*Platanista gangetica gangetica*	Ganges river dolphin
093	*Platanista gangetica minor*	Indus river dolphin
094	*Inia geoffrensis*	Boto, Amazon river dolphin
095	*Lipotes vexillifer*	Baiji
096		Unidentified cetacean
097		Unidentified object, possible marine mammal
098		Unidentified whale
099	*Balaenoptera borealis/edeni*	Rorqual identified as a Sei or Bryde's whale
100	*Stenella longirostris* (Tres Marías)	Tres Marías spinner dolphin
101	*Stenella longirostris* (southwestern)	Southwestern spinner dolphin
102	*Stenella longirostris longirostris*	Gray's spinner dolphin

Appendix 3. SWFSC sighting category codes (continued).

Code	Scientific Name	Standard Common Name
103	*S. longirostris orient./centroam.*	Undetermined eastern or Cent. Am. spinner dolphin
104	*Balaenoptera bonaerensis*	Antarctic minke whale
105	*Tursiops aduncas*	Indian Ocean bottlenose dolphin
106	*Mesoplodon bahamondi*	Bahamonde's beaked whale
107	*Stenella longirostris roseiventris*	Dwarf spinner dolphin
108	*Balaena glacialis glacialis*	North Atlantic right whale
AA	*Arctocephalus australis*	South American fur seal
AG	*Arctocephalus galapagoensis*	Galapagos fur seal
AT	*Arctocephalus townsendi*	Guadalupe fur seal
AZ	*Arctocephalus gazella*	Antarctic fur seal
CU	*Callorhinus ursinus*	Northern fur seal
EB	*Erignathus barbatus*	Bearded seal
EJ	*Eumetopias jubatus*	Stellar sea lion
MA	*Mirounga angustirostris*	Northern elephant seal
OB	*Otaria byronia*	South American sea lion
OR	*Odobenus rosmarus*	Pacific walrus
PC	*Phoca caspica*	Caspian seal
PF	*Phoca fasciata*	Ribbon seal
PH	*Phoca hispida*	Ringed seal
PL	*Phoca largha*	Spotted seal
PU		Unidentified Pinniped
PV	*Phoca vitulina*	Harbor seal
UA		Unidentified fur seal
UO		Unidentified sea lion
US		Unidentified seal
ZC	*Zalophus californianus*	California sea lion
EL	*Enhydra lutris*	Sea otter
HG	*Hydrodamalis gigas*	Stellar sea cow
TI	*Trichechus inunguis*	Amazon manatee
TM	*Trichechus manatus*	West Indian manatee
CC	*Caretta Caretta*	Loggerhead sea turtle
CM	*Chelonia mydas/agassizi*	Green/Black sea turtle
DC	*Dermochelys coriacea*	Leatherback sea turtle
EI	*Eretmochelys imbricata*	Hawksbill sea turtle
LK	*Lepidochelys kempi*	Kemp's Ridley sea turtle
LV	*Lepidochelys olivacea*	Olive Ridley sea turtle
ND	*Natator depresus*	Flatback sea turtle
UH		Unidentified hardshell sea turtle
UT	Chelonidae	Unidentified sea turtle

Appendix 4. Example of an observer logbook entry.



092 8/15/99

Sight.	B	H	L	Species	%
#1223	2	2	2	P. macrocephalus	100
"	12	14	8	" "	"
#1224	150	175	100	S. attenuata attenuata	50
	150	175	150	S. longirostris orientalis	50
	300	350	200	TOTAL	
#1226	70	80	60	S. attenuata attenuata	100
#1227	ESTIMATES MADE BY HELO-SEE SIGHTING FORM			S. attenuata sp	
				S. longirostris sp	

8/15/99 092

Notes
- 10 MINUTE ESTIMATE
- 2 ♂?, 1st subsurface then down and fluke; large lump; 90 min @ 10:10
- 90 MINUTE ESTIMATE
- CALIBRATION
- #1228 Pm photos

Appendix 5. 1998 SPAM tracker data and Merge program description.

Tracker Operations

During the 1998 Stenella Population and Abundance Monitoring (SPAM) Cruise 1611 of the NOAA Ship *Endeavor*, marine mammal "tracker" observations were conducted from an upper mast platform (17.9 meters above waterline) equipped with one 24x150 binocular and a laptop computer with WinCruz and input from the ship's GPS (for time and position). Mammal observers individually rotated through a thirty-minute watch on this platform following their primary watch rotation on the flying bridge. A tracker was on duty most, but not all, of the time the primary team was on duty. The tracker searched the area from 45° left to 45° right of the ship's trackline as far as possible in front of the ship. If the tracker detected a group of cetaceans before it was seen by the primary team on the flying bridge, he/she stopped searching and followed the group until the animals were either detected by the primary team or passed undetected abeam of the vessel. The tracker was aware of flying bridge sightings via one-way intercom, but observers on the flying bridge were not aware of sightings made by the tracker. Once a tracker sighting was seen by the primary observer team on flying bridge, the tracker resumed searching for other undetected schools. Thus, tracker search effort was not continuous. Tracker search effort data may be used to determine dolphin school movement ahead of the vessel and to estimate the proportion of sightings missed by the primary observer team (cf. Buckland and Turnock, Biometrics 48:901-909 (1992)).

Raw Tracker Data

Tracker data were written to daily computer "das" files named Trackall.[date]. These files contained B, R, P, Q, V, N, W, E, C and S-A-1 events/event sequences. Generally the P, V and W event records were blank beyond the 39th column. Tracker effort commenced with a B-R-Q or R-Q event sequence with the tracker observer identity code in columns 40-44 of the Q event record. Tracker effort ended with an E event.

Tracker sightings were recorded with S-A-1 event sequences in the usual "das" method. Sighting numbers were sequential beginning with 1000 (to distinguish from the primary team sightings that began with 1). A sighting that was recorded by the tracker but later determined to have been first detected by the primary team was "commented out" or otherwise deleted from the file. For this and other reasons, there may be frequent breaks in the tracker sighting number sequence.

Tracker Data Preparation/Processing

1. Daily "Trackall" files for the entire cruise were concatenated to create the file Trak1611.das.

2. The data were cursorily edited using a modified version of DasCheck.

Appendix 5. 1998 SPAM tracker data and Merge program description (continued).

3. The temporary placeholder data, "Best", "High", "Low", "%S1", "%S2", "%S3", "%S4", contained in the tracker Event 1 record were replaced with actual tracker school size and species composition values when available. When no school size estimate was available, then a low estimate of 1 was provided.

4. Event codes S and s were converted to K and k, respectively, using an interactive "find and replace" edit tool.

5. Tracker sightings of schools subsequently detected (i.e., "matched") by the primary observer team were determined on a case by case basis from observer notes on the sighting forms or comments in the data files. For each matched sighting, the tracker sighting number was inserted in columns 85-89 of the corresponding S event record in the primary observer das data file (SPAM1611.das). For probable matches the negative sighting number was inserted in columns 85-89 of the S event record of the primary observer das data. The tracker sighting category identity code (species/stock code) was made to agree with that of the primary team sighting for all matched sightings. This included inserting a ? event record in the tracker data for probable species/stock identifications.

6. The tracker data (Trak1611.das) and primary observer team data (SPAM1611.das) were collated chronologically ("merged") by the program Merge written by Katie Cramer. This program copies the K, k, A, 1, ?, Q, and E event records of the tracker file to the merged data file. The event code E in the tracker file is changed to Q in the merged file. All records except Q event records from the primary observer team data file are copied to the merged file. The Merge subroutine Effort then changes the on-effort dots (column 5) in the merged data file so that they are correct with respect to the primary observer team's effort status.

7. The merged data were edited using the standard version of DasCheck.

Merged Data

A Q event with an observer identity code in columns 40-44 indicates a tracker observer is on duty. A Q event with no observer identity code in columns 40-44 indicates the end of tracker observation duty.

Tracker sightings are indicated by K-A-1 or K-A-?-1 event sequences. All sightings made by the primary observer team (whether initially detected by the tracker or not) are indicated by the usual S-A-1…8 or S-A-?-1…8 event sequences. Columns 85-89 of an S event record contain the tracker sighting number for "matched" and negative tracker sighting number for "probable matched" sightings. There is no associated S-A-1...8 event sequence for a tracker sighting that was not subsequently detected by the primary observer team.

Appendix 5. 1998 SPAM tracker data and Merge program description (continued).

For matched sightings, the species/stock code provided by the tracker should agree with that provided by the primary observer team. The school size estimates and species composition provided by the tracker are confined to the tracker sighting K-A-1 event sequence and are not added to corresponding primary observer team's sighting S-A-1...8 event sequence.

Resightings of tracker sightings (by the tracker) are indicated by "k".

Appendix 6A. 1998-2000 survey edit (DasCheck) specifications: value ranges and blank tests.

Variable Name	Column	Char Type	Blank OK?	Range or Values
SEQUENCE	1-3	NUM	OK	(N/A)
EVENT	4	CHR	NO	*, 1-8, A, B, C, E, F, f, K, k, N, P, Q, R, r, S, s, t, V, W, ?, #
ON_EFFORT	5	CHR	OK	.
HOUR	6-7	NUM	OK	5-20
MINUTE	8-9	NUM	OK	0-59
SECOND	10-11	NUM	OK	0-59
MONTH	13-14	NUM	OK	1-12
DAY	15-16	NUM	OK	1-31
YEAR	17-18	NUM	OK	00, 74-99
N_OR_S	20	CHR	OK	N, S
LATD	21-22	NUM	OK	0-48
LATM	24-28	NUM	OK	0.00-59.99
E_OR_W	30	CHR	OK	W
LONGD	31-33	NUM	OK	77-160
LONGM	35-39	NUM	OK	0.00-59.99
(B) CRUISE_NUMBER	41-44	NUM	NO	
MODE	46-49	CHR	NO	C, c, P, p
DEV_FROM_GMT	51-54	NUM	NO	5-11
(C) COMMENT	41-180	CHR	OK	
(t) TDETEC_BY	41-44	NUM	NO	(OBSCODES.DAT)
SP_CODE	48-49	CHR	NO	CC, CM, DC, EI, LV, PU, UH, UO, UT
TBEARING	51-54	NUM	NO	0-359
TDISTANCE	56-59	NUM	NO	0.0-3.0
NUM_TURTLES	61-64	NUM	NO	1-5
ASSOC_JFR	66-69	CHR	OK	F-RJF
TRETICLE	70-74			
MATURITY	75-79			
CAPTURED	80-84			
(P) LEFT_BINO	41-44	NUM	NO	(OBSCODES.DAT)
REC	46-49	NUM	NO	(OBSCODES.DAT)
RIGHT_BINO	51-54	NUM	NO	(OBSCODES.DAT)
IND_OBS	56-59	NUM	OK	(OBSCODES.DAT)

Appendix 6A. 1998-2000 survey edit (DasCheck) specifications (continued).

Variable Name	Column	Char Type	Blank OK?	Range or Values
(V) BEAUFORT	41-44	NUM	NO	0-6
SWELL_HT	46-49	NUM	OK	0.0-10.0
SWELL_DIR	51-54	NUM	OK	0-360
WIND_SPEED	61-64	NUM	OK	0.0-30.0
(N) COURSE	41-44	NUM	NO	0-359
SPEED	46-49	NUM	NO	5.0-13.9
(W) FOG_OR_RAIN	41-44	NUM	NO	1-5
HORIZ_SUN	46-49	NUM	OK	0-12
VERT_SUN	51-54	NUM	OK	0, 1, 2, 3, 12
WIND_DIR	56-59	NUM	OK	0-360
VISIBILITY	61-64	NUM	OK	1.0-10.0
(S,K) SIGHT	41-44	NUM	NO	1-5000
DETEC_BY	46-49	NUM	NO	(OBSCODES.DAT)
SIGHTING_Q	51-54	NUM	NO	1-7
SIGHTING_METHOD	56-59	NUM	NO	1, 2, 4, 5, 6, 7
BEARING	61-64	NUM	NO	0-359
RETICLE	66-69	NUM	OK	0.1-20.0
DISTANCE	71-74	NUM	NO	0.0-6.0
MM_HEADING	76-79	NUM	OK	0-359
MM_SPEED	81-84	NUM	OK	0.0-10.0
(A) SIGHT	41-44	NUM	NO	1-5,000
PHOTOS	51-54	CHR	OK	Y, y, N, n
BIRDS	56-59	CHR	NO	Y, y, N, n
SP1_CODE	61-64	CHR	NO	(SPPCODES.DAT)
SP2_CODE	66-69	CHR	OK	(SPPCODES.DAT)
SP3_CODE	71-74	CHR	OK	(SPPCODES.DAT)
SP4_CODE	76-79	CHR	OK	(SPPCODES.DAT)
(s,k) SIGHT	41-44	NUM	NO	1-5000
BEARING	46-49	NUM	OK	0-359
RETICLE	51-54	NUM	OK	0.1-20.0
DISTANCE	56-59	NUM	OK	0.0-6.0
COURSE	61-64	NUM	OK	0-359
(F,f) BOAT_DET_BY	41-44	NUM	NO	(OBSCODES.DAT)
BEARING	46-49	NUM	OK	0-359
DISTANCE	51-54	NUM	OK	0.0-6.9
RETICLE	56-59	NUM	OK	0.1-20.0

Appendix 6A. 1998-2000 survey edit (DasCheck) specifications (continued).

Variable Name	Column	Char Type	Blank OK?	Range or Values
(Q)OBS_A (TRACKER)	41-44	NUM	OK	(OBSCODES.DAT)
OBS_B	46-49	NUM	OK	(OBSCODES.DAT)
OBS_C	51-54	NUM	OK	(OBSCODES.DAT)
OBS_D	56-59	NUM	OK	(OBSCODES.DAT)
(?)SIGHT	41-44	NUM	NO	1-5000
SP1_CODE	61-64	NUM	NO	(SPPCODES.DAT)
SP2_CODE	66-69	NUM	OK	(SPPCODES.DAT)
SP3_CODE	71-74	NUM	OK	(SPPCODES.DAT)
SP4_CODE	76-79	NUM	OK	(SPPCODES.DAT)
(1-8)OBS_CODE	41-44	NUM	NO	(OBSCODES.DAT)
BST_EST_SCHL	46-49	NUM	OK	1-2000
HI_EST_SCHL	51-54	NUM	OK	1-2000
LO_EST_SCHL	56-59	NUM	NO	1-2000
SP1_PERCENT	61-64	NUM	NO	1-100
SP2_PERCENT	66-69	NUM	OK	0-99
SP3_PERCENT	71-74	NUM	OK	0-98
SP4_PERCENT	76-79	NUM	OK	0-97

Appendix 6B. 1998-2000 survey data edit (DasCheck) specifications: logical tests.

ERROR 1	EVENT (4:4) must be equal to '*', '#', '?', '1', '2', '3', '4', '5', '6', '7', '8', 'A', 'B', 'C', 'E', 'F', 'f', 'K', 'k', 'N', 'P', 'R', 'S', 'V', 'W', 'Q', 'r', 's' or 't'.
ERROR 2	If EVENT (4:4) is equal to 'A', then the previous occurrence of EVENT must be equal to 'S' or 'K'
ERROR 3	If EVENT (4:4) is equal to '?', then the previous occurrence of EVENT must be equal to 'A'.
ERROR 4	If EVENT (4:4) is equal to '2', then the previous occurrence of EVENT must be equal to '1'.
ERROR 5	If EVENT (4:4) is equal to '3', then the previous occurrence of EVENT must be equal to '2'.
ERROR 6	If EVENT (4:4) is equal to '4', then the previous occurrence of EVENT must be equal to '3'.
ERROR 7	If EVENT (4:4) is equal to '5', then the previous occurrence of EVENT must be equal to '4'.
ERROR 8	If EVENT (4:4) is equal to '6', then the previous occurrence of EVENT must be equal to '5'.
ERROR 9	If the previous occurrence of EVENT (4:4) is equal to 'A', then the present occurrence of EVENT must be equal to '1' or '?' or 'C'.
ERROR 10	If EVENT (4:4) is equal to '7', then the previous occurrence of EVENT must be equal to '6'.
ERROR 11	If EVENT (4:4) is equal to '8', then the previous occurrence of EVENT must be equal to '7'.
ERROR 12	If EVENT (4:4) is equal to '1', then the previous occurrence of EVENT must be equal to '?' or 'A'.
ERROR 13	If EVENT (4:4) is equal to 'B', then the next occurrence of EVENT must be equal to 'R' or 'r'.
ERROR 103	If ON_EFFORT (5:5) is not blank, then ON_EFFORT must be equal to '.'.

Appendix 6B. 1998-2000 survey data edit (DasCheck) logical tests (continued).

ERROR 104 If HOUR (6:7) is not blank, then HOUR should be greater than or equal to '5' and less than or equal to '20'.

ERROR 105 If MINUTE (8:9) is not blank, then MINUTE must be greater than or equal to '0' and less than or equal to '59'.

ERROR 106 If SECOND (10:11) is not blank, then SECOND must be greater than or equal to '0' and less than or equal to '59'.

ERROR 107 If MONTH (13:14) is not blank, then MONTH must be greater than or equal to '1' and less than or equal to '12'.

ERROR 108 If DAY (15:16) is not blank, then DAY must be greater than or equal to '1' and less than or equal to '31'.

ERROR 109 If YEAR (17:18) is not blank, then YEAR must be equal to '00' or greater than or equal to '74'.

ERROR 110 If N_OR_S (20:20) is not blank, then N_OR_S must be equal to 'N' or 'S'.

ERROR 111 If LATD (21:22) is not blank, then LATD should be greater than or equal to '00' and less than or equal to '48'.

ERROR 112 If LATM (24:28) is not blank, then LATM should be greater than or equal to '0.00' and less than or equal to '59.99'.

ERROR 113 If E_OR_W (30:30) is not blank, then E_OR_W must be equal to 'W'.

ERROR 114 If LONGD (31:33) is not blank, then LONGD should be greater than or equal to '77' and less than or equal to '160'.

ERROR 115 If LONGM (35:39) is not blank, then LONGM must be greater than or equal to '0.00' and less than or equal to '59.99'.

*********This check removed for 1999 and subsequent edits *******

~~ERROR 116 If EVENT (4:4) is equal to 'B', then CRUISE (41:44) must be equal to '1610', '1611', or '1612'.~~

ERROR 118 If EVENT (4:4) is equal to 't', then TDETEC_BY (41:44) should be found on the list of participating observer codes (file OBSCODES.DAT).

Appendix 6B. 1998-2000 survey data edit (DasCheck) logical tests (continued).

ERROR 119	If EVENT (4:4) is equal to 't', then SP_CODE (46:49) must be equal to 'CC', 'CM', 'DC', 'EI', 'LV', 'PU', 'UH', 'UO' or 'UT'.
ERROR 120	If EVENT (4:4) is equal to 't', then TBEARING (51:54) should not be blank and must be greater than or equal to '0' and less than or equal to '359'.
ERROR 121	If EVENT (4:4) is equal to 't', then TDISTANCE (56:59) should not be blank and should be greater than or equal to '0.0' and less than or equal to '3.0'.
ERROR 122	If EVENT (4:4) is equal to 't', then NUM_TURTLES (61:64) should not be blank and should be greater than or equal to '1' and less than or equal to '5'.
ERROR 123	If EVENT (4:4) is equal to 't' and ASSOC_JFR (66:69) is not blank, then ASSOC_JFR must be equal to 'F', 'J' or 'R' (any or all, in any order).
ERROR 124	If EVENT (4:4) is equal to 'P', then RIGHT_BINO (51:54) should be found on the list of participating observer codes (file OBSCODES.DAT).
ERROR 125	If EVENT (4:4) is equal to 'P', then REC (46:49) should be found on the list of participating observer codes (file OBSCODES.DAT).
ERROR 126	If EVENT (4:4) is equal to 'P', then LEFT_BINO (41:44) should be found on the list of participating observer codes (file OBSCODES.DAT).
ERROR 127	If EVENT (4:4) is equal to 'P' and IND_OBS (56:59) is not blank, then IND_OBS should be found on the list of participating observer codes (file OBSCODES.DAT).
ERROR 128	If EVENT (4:4) is equal to 'V', then BEAUFORT (41:44) should not be blank and should be greater than or equal to '0' and less than or equal to '6'.
ERROR 129	If EVENT (4:4) is equal to 'V' and SWELL_HT (46:49) is not blank, then SWELL_HT should be greater than or equal to '0.0' and less than or equal to '10.0'.

Appendix 6B. 1998-2000 survey data edit (DasCheck) logical tests (continued).

ERROR 130	If EVENT (4:4) is equal to 'V' and SWELL_DIR (51:54) is not blank, then SWELL_DIR must be greater than or equal to '0' and less than or equal to '360'.
ERROR 132	If EVENT (4:4) is equal to 'N', then COURSE (41:44) should not be blank and must be greater than or equal to '0' and less than or equal to '359'.
ERROR 133	If EVENT (4:4) is equal to 'N' and ON_EFFORT (5:5) is equal to '.', then SPEED (46:49) should not be blank and should be greater than or equal to '5.0' and less than or equal to '13.9'.
ERROR 134	If EVENT (4:4) is equal to 'W', then FOG_OR_RAIN (41:44) should not be blank and must be greater than or equal to '1' and less than or equal to '5'.
ERROR 135	If EVENT (4:4) is equal to 'W' and HORIZ_SUN (46:49) is not blank, then HORIZ_SUN must be greater than or equal to '0' and less than or equal to '12'.
ERROR 136	If EVENT (4:4) is equal to 'W' and VERT_SUN (51:54) is not blank, then VERT_SUN must be equal to '0', '1', '2', '3' or '12'.
ERROR 137	If EVENT (4:4) is equal to 'W' and WIND_DIR (56:59) is not blank, then WIND_DIR must be greater than or equal to '0' and less than or equal to '360'.
ERROR 138	If EVENT (4:4) is equal to 'W' and VISIBILITY (61:64) is not blank, then VISIBILITY should be greater than or equal to '1.0' and less than or equal to '10.0'.
ERROR 139	If EVENT (4:4) is equal to 'S' or 'K', then SIGHT must be greater than or equal to '1' and less than or equal to '5000'.
ERROR 140	If EVENT (4:4) is equal to 'S' or 'K', then DETEC_BY (46:49) should be found on the list of participating observer codes (file OBSCODES.DAT).
ERROR 141	If EVENT (4:4) is equal to 'S' or 'K', then SIGHTING_Q (51:54) must be greater than or equal to '1' and less than or equal to '7'.
ERROR 142	If EVENT (4:4) is equal to 'S' or 'K', then SIGHTING_METHOD (56:59) must be equal to '1', '2', '4', 5', '6', or '7'.

Appendix 6B. 1998-2000 survey data edit (DasCheck) logical tests (continued).

ERROR 143	If EVENT (4:4) is equal to 'S' or 'K', then BEARING (61:64) should not be blank and must be greater than or equal to '0' and less than or equal to '359'.
ERROR 144	If EVENT (4:4) is equal to 'S' or 'K' and RETICLE (66:69) is not blank, then RETICLE should be greater than or equal to '0.1' and less than or equal to '20.0'.
ERROR 145	If EVENT (4:4) is equal to 'S' or 'K', then DISTANCE (71:74) should not be blank and should be greater than or equal to '0' and less than or equal to '6.0'.
ERROR 146	If EVENT (4:4) is equal to 'A' or '?', then SIGHT must be greater than or equal to '1' and less than or equal to '5000'.
ERROR 148	If EVENT (4:4) is equal to 'A' and PHOTOS (51:54) is not blank, then PHOTOS must be equal to 'Y', 'y', 'N', or 'n'.
ERROR 149	If EVENT (4:4) is equal to 'A', then BIRDS (56:59) must be equal to 'Y', 'y', 'N', or 'n'.
ERROR 150	If EVENT (4:4) is equal to 'A' or '?', then SP1_CODE (61:64) should be found on the list of valid species codes (file SPPCODES.DAT).
ERROR 151	If EVENT (4:4) is equal to 'A' or '?' and SP2_CODE (66:69) is not blank, then SP2_CODE should be found on the list of valid species codes (file SPPCODES.DAT).
ERROR 152	If EVENT (4:4) is equal to 'A' or '?' and SP3_CODE (71:74) is not blank, then SP3_CODE should be found on the list of valid species codes (file SPPCODES.DAT).
ERROR 153	If EVENT (4:4) is equal to 'A' or '?' and SP4_CODE (76:79) is not blank, then SP4_CODE should be found on the list of valid species codes (file SPPCODES.DAT).
ERROR 157	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7', or '8', then OBS_CODE (41:44) should be found on the list of participating observer codes (file OBSCODES.DAT).
ERROR 158	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7', or '8' and BST_EST_SCHL (46:49) is not blank, then BST_EST_SCHL should be greater than or equal to '1' and less than or equal to '2000'.

Appendix 6B. 1998-2000 survey data edit (DasCheck) logical tests (continued).

ERROR 159	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7', or '8' and HI_EST_SCHL (51:54) is not blank, then HI_EST_SCHL should be greater than or equal to '1' and less than or equal to '2000'.
ERROR 160	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7', or '8', then LO_EST_SCHL should be greater than or equal to '1' and less than or equal to '2000'.
ERROR 161	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7', or '8', then SP1_PERCENT (61:64) should be greater than or equal to '1' and less than or equal to '100'.
ERROR 162	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7', or '8', and SP2_PERCENT (66:69) is not blank, then SP2_PERCENT should be greater than or equal to '0' and less than or equal to '99'.
ERROR 163	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7', or '8' and SP3_PERCENT (71:74) is not blank, then SP3_PERCENT should be greater than or equal to '0' and less than or equal to '98'.
ERROR 164	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7', or '8' and SP4_PERCENT (76:79) is not blank, then SP4_PERCENT should be greater than or equal to '0' and less than or equal to '97'.
ERROR 165	If EVENT (4:4) is equal to 's' or 'k', then SIGHTING_NO (41:44) should be equal to one of the last three previous occurrences of SIGHT (EVENT 'A' (41:44)).
ERROR 166	If EVENT (4:4) is equal to 's' or 'k' and COURSE (46:49) is not blank, then COURSE (46:49) must be greater than or equal to '0' and less than or equal to '359'.
ERROR 167	If EVENT (4:4) is equal to 's' or 'k' and RETICLE (51:54) is not blank, then RETICLE must be greater than or equal to '0.1' and less than or equal to '20.0'.
ERROR 168	If EVENT (4:4) is equal to 's' or 'k' and DISTANCE (56:59) is not blank, then DISTANCE must be greater than or equal to '0.0' and less than or equal to '6.0'.
ERROR 169	If EVENT (4:4) is equal to 's' or 'k' and BEARING (61:64) is not blank, then BEARING must be greater than or equal to '0' and less than or equal to '359'.

Appendix 6B. 1998-2000 survey data edit (DasCheck) logical tests (continued).

ERROR 170	If EVENT (4:4) is equal to 'S' or 'K' and MM_HEADING (76:79) is not blank, then MM_HEADING must be greater than or equal to '0' and less than or equal to '359'.
ERROR 171	If EVENT (4:4) is equal to 'S' or 'K' and MM_SPEED (81:84) is not blank, then MM_SPEED should be greater than or equal to '0.0' and less than or equal to '10.0'.
ERROR 172	If EVENT (4:4) is equal to 'F' or 'f', then BOAT_DET_BY (41:44) should be found on the list of participating observer codes (file OBSCODES.DAT).
ERROR 173	If EVENT (4:4) is equal to 'F' or 'f' and BOAT_COURSE (46:49) is not blank, then BOAT_COURSE must be greater than or equal to '0' and less than or equal to '359'.
ERROR 174	If EVENT (4:4) is equal to 'F' or 'f' and DISTANCE (51:54) is not blank, then DISTANCE should be greater than or equal to '0.0' and less than or equal to '6.9'.
ERROR 175	If EVENT (4:4) is equal to 'F' or 'f' and RETICLE (56:59) is not blank, then RETICLE should be greater than or equal to '0.1' and less than or equal to '20.0'.
ERROR 176	If EVENT (4:4) is equal to 'V' and WIND_SPEED (61:64) is not blank, then WIND_SPEED should be greater than or equal to '0.0' and less than or equal to '30.0'.
ERROR 205	If EVENT (4:4) is equal to 'R' or 'r', then ON_EFFORT (5:5) must be equal to '.'.
ERROR 206	If EVENT is equal to 'A', 'E', 'F', 'K', 'Q', 'R', 'r', 'S' or 't', then HOUR (6:7), MINUTE(8:9), MONTH(13:14), DAY(15:16), YEAR(17:18), N_OR_S(20:20), LATD(21:22), LATM (24:25), E_OR_W(30:30), LONGD(31:33) and LONGM (35:36) must all be not blank.
ERROR 207	If EVENT (4:4) is equal to 'E', then ON_EFFORT (5:5) must be equal to '.'.
ERROR 208	If EVENT (4:4) is equal to 'P', 'V', 'N' or 'W' and ON_EFFORT (5:5) is equal to '.', then N_OR_S (20:20), LATD (21:22), LATM (24:25), E_OR_W (30:30), LONGD (31:33) and LONGM (35:36) must all be not blank.

Appendix 6B. 1998-2000 survey data edit (DasCheck) logical tests (continued).

ERROR 210	If EVENT (4:4) is equal to 'P', then non-blank values for RIGHT_BINO (51:54), REC (46:49), LEFT_BINO (41:44) and any value for IND_OBS (56:59) must each be unique for these four fields.
ERROR 215	If EVENT (4:4) is equal to 'W' and HORIZ_SUN (46:49) is not blank, then VERT_SUN (51:54) should not be blank.
ERROR 220	If EVENT (4:4) is equal to 'W' and VERT_SUN (51:54) is not blank, then HORIZ_SUN (46:49) should not be blank.
ERROR 225	If EVENT (4:4) is equal to 'A' or '?' and SP2_CODE (66:69) is not blank, then SP1_CODE (61:64) must not be blank.
ERROR 227	If EVENT (4:4) is equal to 'S' or 'K' and ON_EFFORT is equal to '.', then BEARING (61:64) should be less than or equal to '90' or greater than or equal to '270'.
ERROR 230	If EVENT (4:4) is equal to 'A' or '?' and SP3_CODE (71:74) is not blank, then SP2_CODE (66:69) must not be blank.
ERROR 231	If EVENT (4:4) is equal to 'A' or '?' and SP4_CODE (76:79) is not blank, then SP3_CODE (71:74) must not be blank.
ERROR 235	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7', or '8', then ON_EFFORT (5:5) must be blank.
ERROR 240	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7', or '8' and BST_EST_SCHL (46:49) and HI_EST_SCHL (51:54) are both not blank, then BST_EST_SCHL must be less than or equal to HI_EST_SCHL.
ERROR 245	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7', or '8', and BST_EST_SCHL (46:49) and LO_EST_SCHL (56:59) are both not blank, then BST_EST_SCHL must be greater than or equal to LO_EST_SCHL.
ERROR 250	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7', or '8', and HI_EST_SCHL (51:54) and LO_EST_SCHL (56:59) are both not blank, then HI_EST_SCHL must be greater than or equal to LO_EST_SCHL.
ERROR 256	If EVENT (4:4) is equal to 'B', then MODE (46:49) must be equal to 'C', 'c', 'P' or 'p'.

Appendix 6B. 1998-2000 survey data edit (DasCheck) logical tests (continued).

ERROR 257	If EVENT (4:4) is equal to 'B', then DEV_FROM_GMT (51:54) must be greater than or equal to '5' and less than or equal to '11'.
ERROR 260	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7', or '8' and SP1_PERCENT (61:64), SP2_PERCENT (66:69), SP3_PERCENT (71:74) or SP4_PERCENT (76:79) is not blank, then the sum of SP1_PERCENT, SP2_PERCENT, SP3_PERCENT and SP4_PERCENT should be equal to '100'.
ERROR 265	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7', or '8', then one of the following fields must not be blank: BST_EST_SCHL (46:49), HI_EST_SCHL (51:54) or LO_EST_SCHL (56:59).
ERROR 304	If MONTH (13:14), DAY (15:16) and YEAR (17:18) are all not blank, then the date (YEAR//MONTH//DAY) must not be less than the previous occurrence of date.
ERROR 308	If HOUR (6:7), MINUTE (8:9) and DAY (15:16) are all not blank and DAY is equal to the previous occurrence of DAY, then time (HOUR//MINUTE) must not be less than the previous occurrence of time.
ERROR 312	If N_OR_S (20:20), LATD (21:22), LATM (24:28), E_OR_W (30:30), LONGD (31:33), LONGM (35:39), HOUR (6:7) and MINUTE (8:9) are all not blank, then the distance between the present position and the position on the last record with non-blank occurrences of N_OR_S, LATD, LATM, E_OR_W, LONGD, LONGM, HOUR and MINUTE should be less than or equal to 2.8 nautical miles, if the elapsed time between the present and previous times (HOUR//MINUTE) is less than or equal to 10 minutes.
ERROR 313	If N_OR_S (20:20), LATD (21:22), LATM (24:28), E_OR_W (30:30), LONGD (31:33), LONGM (35:39), HOUR (6:7) and MINUTE (8:9) are all not blank, then the distance between the present position and the position on the last record with non-blank occurrences of N_OR_S, LATD, LATM, E_OR_W, LONGD, LONGM, HOUR and MINUTE should be less than or equal to 15.5 (knots) x elapsed time (hours), if the elapsed time between the present and previous times (HOUR//MINUTE) is greater than 10 minutes.
ERROR 320	If EVENT (4:4) is equal to 'B', then CRUISE (41:44) should be equal to the previous occurrence of CRUISE (EVENT 'B'; 41:44).

Appendix 6B. 1998-2000 survey data edit (DasCheck) logical tests (continued).

ERROR 324	If EVENT (4:4) is not equal to '1', '2', '3', '4', '5', '6', '7', '8', 'E' or '?' and the last occurrence of EVENT equal to 'B', 'R' or 'r' has not been succeeded by an occurrence of EVENT equal to 'E', then ON_EFFORT (5:5) must be equal to '.'.
ERROR 325	If EVENT (4:4) is equal to 'R' or 'r', then the last occurrence of EVENT equal to 'R' or 'r' must be succeeded by an occurrence of EVENT equal to 'E'.
ERROR 326	If EVENT (4:4) is equal to 'E', then the last occurrence of EVENT equal to 'E' must be succeeded by an occurrence of EVENT equal to 'R' or 'r'.
ERROR 327	If EVENT (4:4) is equal to 'B', then the last occurrence of EVENT equal to 'B' must be on a different date than the present occurrence of 'B'.
ERROR 328	If EVENT (4:4) is not equal to '1', '2', '3', '4', '5', '6', '7', '8', '?', 'E', 'B', 'R' or 'r' and the last occurrence of EVENT equal to 'E' has not been succeeded by an occurrence of EVENT equal to 'B', 'R' or 'r', then ON_EFFORT (5:5) must be blank.
ERROR 340	If EVENT (4:4) is equal to 'P' and the previous occurrence of EVENT equal to 'P' has not been succeeded by an occurrence of EVENT equal to 'E', then time [HOUR (6:7) and MINUTE (8:9)] minus the previous occurrence of time (EVENT 'P'; 6:7, 8:9) should be less than or equal to one hour.
ERROR 350	If EVENT (4:4) is equal to 'S' or 'K', SIGHT (41:44) is not equal to '1' and the previous occurrence of SIGHT (EVENT 'S' or 'K'; 41:44) is not blank, then SIGHT must be equal to the previous occurrence of SIGHT plus 1.
ERROR 356	If EVENT (4:4) is equal to 'S' and ON_EFFORT (5:5) is equal to '.', then DETEC_BY (46:49) must be equal to the previous occurrence of RIGHT_BINO, REC, LEFT_BINO or IND_OBS (EVENT 'P'; 51:54, 46:49, 41:44, 56:59).
ERROR 360	If EVENT (4:4) is equal to 'S', ON_EFFORT is equal to '.' and DETEC_BY (46:49) is equal to the previous occurrence of either RIGHT_BINO (EVENT 'P'; 51:54) or LEFT_BINO (EVENT 'P'; 41:44), then SIGHTING_METHOD (56:59) should be equal to '4'.

Appendix 6B. 1998-2000 survey data edit (DasCheck) logical tests (continued).

ERROR 364 If EVENT (4:4) is equal to 'S', ON_EFFORT is equal to '.' and DETEC_BY (46:49) is equal to the previous occurrence of IND_OBS (EVENT 'P'; 56:59), then SIGHTING_METHOD (56:59) should be equal to '1', '2', '4', '5' or '6'.

*********This check removed for 1999 and subsequent edits *******

~~ERROR 365 If EVENT (4:4) is equal to 'S' and SIGHTING_METHOD (56:59) is equal to '8', then ON_EFFORT (5:5) must be equal to '.' and DETEC_BY (46:49) must be equal to the previous occurrence of IND_OBS (EVENT 'P'; 56:59).~~

ERROR 368 If EVENT (4:4) is equal to 'S', ON_EFFORT is equal to '.' and DETEC_BY (46:49) is equal to the previous occurrence of REC (EVENT 'P'; 46:49), then SIGHTING_METHOD (56:59) should be equal to '1', '2' or '5'.

ERROR 369: If EVENT (4:4) is equal to 'S', ON_EFFORT (5:5) is equal to '.' and SIGHTING_METHOD (56:59) is equal to '4', then DETEC_BY (46:49) must be equal to the previous occurrence of LEFT_BINO, RIGHT_BINO, or, IND_OBS (EVENT 'P'; 41:44, 51:54 or 56:59).

ERROR 370: If EVENT (4:4) is equal to 'S', ON_EFFORT (5:5) is equal to '.' and SIGHTING_METHOD (56:59) is equal to '1', '2' or '5', then DETEC_BY (46:49) should be equal to the previous occurrence of REC or IND_OBS (EVENT 'P'; 46:49 or 56:59).

ERROR 371: If EVENT (4:4) is equal to 'S', ON_EFFORT (5:5) is equal to '.' and SIGHTING_METHOD (56:59) is equal to '6' or '7', then DETEC_BY (46:49) should not be equal to the previous occurrence of LEFT_BINO, REC, RIGHT_BINO or IND_OBS (EVENT 'P'; 41:44, 46:49, 51:54 or 56:59).

ERROR 372 If EVENT (4:4) is equal to 'S', ON_EFFORT is equal to '.', SIGHTING_METHOD (56:59) is equal to '4' and BEARING (61:64) is greater than or equal to '15' and less than or equal to '90', then DETEC_BY (46:49) should be equal to the previous occurrence of RIGHT_BINO or IND_OBS (EVENT 'P'; 51:54 or 56:59).

ERROR 376 If EVENT (4:4) is equal to 'S', ON_EFFORT is equal to '.', SIGHTING_METHOD (56:59) is equal to '4' and BEARING (61:64) is greater than or equal to '270' and less than or equal to '345', then DETEC_BY (46:49) should be equal to the previous occurrence of LEFT_BINO or IND_OBS (EVENT 'P'; 41:44 or 56:59).

Appendix 6B. 1998-2000 survey data edit (DasCheck) logical tests (continued).

ERROR 380	If EVENT (4:4) is equal to 'A' or '?', then SIGHT (41:44) must be equal to the previous occurrence of SIGHT (EVENT 'S' or 'K'; 41:44).
ERROR 384	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7', or '8' and if SP1_PERCENT (61:64) is not blank, then the previous occurrence of SP1_CODE (EVENT 'A'; 61:64) must not be blank.
ERROR 388	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7', or '8' and if SP2_PERCENT (66:69) is greater than '0', then SP1_PERCENT (61:64) should be greater than '0', and the previous occurrence of SP1_CODE and SP2_CODE (EVENT 'A'; 61:64, 66:69) should both not be blank.
ERROR 389	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7' or '8' and if SP2_CODE (EVENT 'A'; 66:69) is non-blank, then SP2_PERCENT (66:69) should be greater than '0'.
ERROR 390	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7' or '8' and SP3_CODE (EVENT 'A'; 71:74) is non-blank, then SP3_PERCENT (71:74) should be greater than '0'.
ERROR 391	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7' or '8' and SP4_CODE (EVENT 'A'; 76:79) is non-blank, then SP4_PERCENT (76:79) should be greater than '0'.
ERROR 392	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7' or '8' and SP3_PERCENT (71:74) is greater than '0', then SP1_PERCENT (61:64) and SP2_PERCENT (66:69) should both be greater than '0', and the previous occurrence of SP1_CODE, SP2_CODE and SP3_CODE (EVENT 'A'; 61:64, 66:69, 71:74) should all not be blank.
ERROR 393	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7' or '8' and SP4_PERCENT (76:79) is greater than '0', then SP1_PERCENT (61:64), SP2_PERCENT (66:69) and SP3_PERCENT (71:74) should all be greater than '0', and the previous occurrence of SP1_CODE, SP2_CODE, SP3_CODE and SP4_CODE (EVENT 'A'; 61:64, 66:69, 71:74, 76:79) should all not be blank.
ERROR 396	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7' or '8', then OBS_CODE (41:44) must not be equal to OBS_CODE for the other observers involved in this sighting, if any.

Appendix 6B. 1998-2000 survey data edit (DasCheck) logical tests (continued).

ERROR 400	If EVENT (4:4) is equal to 'A' or '?', SP1_CODE (61:64), SP2_CODE (66:69), SP3_CODE (71:74) or SP4_CODE (76:79) is equal to '034' and the preceding occurrence (EVENT 'S' or 'K') of N_OR_S (20:20) is not blank, then N_OR_S should be equal to 'S' (south).
ERROR 401	If EVENT (4:4) is equal to 'A' or '?', SP1_CODE (61:64), SP2_CODE (66:69), SP3_CODE (71:74) or SP4_CODE (76:79) is equal to '036' and the preceding occurrence (EVENT 'S' or 'K') of N_OR_S (20:20) is not blank, then N_OR_S should be equal to 'N' (north).
ERROR 402	If EVENT (4:4) is equal to 'A' or '?', SP1_CODE (61:64), SP2_CODE (66:69), SP3_CODE (71:74) or SP4_CODE (76:79) is equal to '006' and the preceding occurrences (EVENT 'S' or 'K') of N_OR_S (20:20), LATD (21:22), LATM (24:28), E_OR_W (30:30), LONGD (31:33), and LONGM (35:39) are all not blank, then the position (N_OR_S, LATD, LATM, E_OR_W, LONGD, and LONGM) should be inside a specified geographical boundary for this species-stock.
ERROR 403	If EVENT (4:4) is equal to 'A' or '?', SP1_CODE (61:64), SP2_CODE (66:69), SP3_CODE (71:74) or SP4_CODE (76:79) is equal to '010' and the preceding occurrences (EVENT 'S' or 'K') of N_OR_S (20:20), LATD (21:22), LATM (24:28), E_OR_W (30:30), LONGD (31:33), and LONGM (35:39) are all not blank, then the position (N_OR_S, LATD, LATM, E_OR_W, LONGD, and LONGM) should be inside a specified geographical boundary for this species-stock.
ERROR 404	If EVENT (4:4) is equal to 'A' or '?', SP1_CODE (61:64), SP2_CODE (66:69), SP3_CODE (71:74) or SP4_CODE (76:79) is equal to '011' and the preceding occurrences (EVENT 'S' or 'K') of N_OR_S (20:20), LATD (21:22), LATM (24:28), E_OR_W (30:30), LONGD (31:33), and LONGM (35:39) are all not blank, then the position (N_OR_S, LATD, LATM, E_OR_W, LONGD, and LONGM) should be inside a specified geographical boundary for this species-stock.
ERROR 405	If EVENT (4:4) is equal to 'A' or '?', SP1_CODE (61:64), SP2_CODE (66:69), SP3_CODE (71:74) or SP4_CODE (76:79) is equal to '016' and the preceding occurrences (EVENT 'S' or 'K') of N_OR_S (20:20), LATD (21:22), LATM (24:28), E_OR_W (30:30), LONGD (31:33), and LONGM (35:39) are all not blank, then the position (N_OR_S, LATD, LATM, E_OR_W, LONGD, and LONGM) should be inside a specified geographical boundary for this species-stock.

Appendix 6B. 1998-2000 survey data edit (DasCheck) logical tests (continued).

ERROR 406	If EVENT (4:4) is equal to 'A' or '?', SP1_CODE (61:64), SP2_CODE (66:69), SP3_CODE (71:74) or SP4_CODE (76:79) is equal to '088' and the preceding occurrences (EVENT 'S' or 'K') of N_OR_S (20:20), LATD (21:22), LATM (24:28), E_OR_W (30:30), LONGD (31:33), and LONGM (35:39) are all not blank, then the position (N_OR_S, LATD, LATM, E_OR_W, LONGD, and LONGM) should be inside a specified geographical boundary for this species-stock.
ERROR 407	If EVENT (4:4) is equal to 'Q' and OBS_A (41:44) is not blank, then OBS_A should be found on the list of participating observer codes (file OBSCODES.DAT).
ERROR 408	If EVENT (4:4) is equal to 'Q' and OBS_B (46:49) is not blank, then OBS_B should be found on the list of participating observer codes (file OBSCODES.DAT).
ERROR 409	If EVENT (4:4) is equal to 'Q' and OBS_C (51:54) is not blank, then OBS_C should be found on the list of participating observer codes (file OBSCODES.DAT).
ERROR 410	If EVENT (4:4) is equal to 'Q' and OBS_D (46:49) is not blank, then OBS_D should be found on the list of participating observer codes (file OBSCODES.DAT).
ERROR 411	If EVENT (4:4) is equal to 'Q', then non-blank values for OBS_A (41:44), OBS_B (46:49), OBS_C (51:54) and OBS_D (56:59) must be unique for these four fields.
ERROR 412	If EVENT (4:4) is equal to 'Q' and OBS_A (41:44) is not blank, then OBS_A must not be equal to the previous occurrence of RIGHT_BINO, REC, LEFT_BINO or IND_OBS (EVENT 'P'; 51:54, 46:49, 41:44, 56:59).
ERROR 413	If EVENT (4:4) is equal to 'P' and the previous occurrence of EVENT equal to 'Q' has not been succeeded by an occurrence of EVENT equal to 'E', then non-blank values for LEFT_BINO, REC, RIGHT_BINO or IND_OBS (41:44, 46:49, 51:54, 56:59) must not be equal to the previous occurrence of tracker OBS_A, OBS_B, OBS_C, or OBS_D, (EVENT 'Q'; 41:44, 46:49, 51:54, 56:59).
ERROR 414	If EVENT (4:4) is equal to '?', and the previous occurrence of SP1_CODE (EVENT 'A'; 61:64) is not blank, then current occurrence of SP1_CODE (61:64) should not be blank.

Appendix 6B. 1998-2000 survey data edit (DasCheck) logical tests (continued).

ERROR 415	If EVENT (4:4) is equal to '?', and the previous occurrence of SP2_CODE (EVENT 'A'; 66:69) is not blank, then current occurrence of SP2_CODE (66:69) should not be blank.
ERROR 416	If EVENT (4:4) is equal to '?', and the previous occurrence of SP3_CODE (EVENT 'A'; 71:74) is not blank, then current occurrence of SP3_CODE (71:74) should not be blank.
ERROR 417	If EVENT (4:4) is equal to '?', and the previous occurrence of SP4_CODE (EVENT 'A'; 76:79) is not blank, then current occurrence of SP4_CODE (76:79) should not be blank.
ERROR 422	If EVENT (4:4) is equal to '1', '2', '3', '4', '5', '6', '7', or '8', then LO_EST_SCHL (56:59) should not be blank

Appendix 7. Sample DasCheck data verification report.

```
Marine Mammal Data Checking Program
 DASCHECK version 3.0
 2/15/2000
 System Time: 10:40:32
 Found and Opened the Data File: STAR1613.DAS

 DASCHECK found the following errors:
 (Numbers in parentheses refer to the column numbers in the DAS file.
  For further explanation of a numbered error, consult SPECS99.DOC)


 -- RECORD #    28
   1                                    149 9945 0100 0030  100  000  000

  * HAS ERROR # 240                                                     *
    School size best estimate (46-49) must be less than or equal to school size
    high estimate (51-54).

    BST_EST_SCHL=0150
    HI_EST_SCHL =0100


 -- RECORD #   123
023S.182654 072899 N32 13.07 W117 05.04 1001  126    6    4  011  0.2 3.69 -090

  * HAS ERROR # 170                                                     *
    Marine mammal heading (76-79) must be between 0 and 359.


    MM_HEADING=-090


 -- RECORD #   480
   2                                    124 0065 0085 0050  100


  * HAS ERROR # 157                                                     *
    Observer code (41-44) should be on the list of participating observer codes
    (obscodes.dat).

    OBS_CODE= 124


-- RECORD #   955
188S.142937 073199 N26 54.00 W114 15.32 1044   91    2    4  288  5.0 0.68  180


  * HAS ERROR # 350                                                     *
    Sighting number (41-44) should be greater by 1 than the previous sighting number
    (event 'A': 41-44).

    SIGHT=1044 PREVIOUS=1042


 -- RECORD #  1072
   2                                    168 0004 0004 0003  100


  * HAS ERROR # 389                                                     *
    Species-2 percent (66-69) should be greater than 0, if species-2 code (event 'A': 66-
    69) is non-blank.

    SP2_CODE=070
    SP2_PERCENT=
```

Appendix 7. Sample DasCheck data verification report (continued).

```
 -- RECORD #  1242
128S.103224 080199 N24 50.57 W112 25.54 1067  126    3    4  047  0.5 2.74


  * HAS ERROR # 372                                                    *
    The observer (46-49) initiating the sighting should be the right-hand
    observer (event 'P': 51-54) or the independent observer if the bearing
    (61-64) is between 15 and 90.

    DETEC_BY(right)= 126 PREVIOUS= 184


 -- RECORD #  1336
218S.134019 080199 N24 29.83 W112 09.96 1071  168    6    6  090      0.01  000


  * HAS ERROR # 360                                                    *
    Sighting method (56-59) should be equal to 4, if this sighting was initiated by
    either the right-hand observer or left-hand observer (event 'P': 41-44, 51-54).

    INITIAL_SIGHTING=   6


  * HAS ERROR # 371                                                    *
    The observer (46-49) initiating the sighting should not be the left-hand
    observer, recorder, right-hand observer or independent observer (event 'P':
    41-44, 46-49, 51-54 or 56-59) if the on-effort indicator (5) is equal to
    '.' and sighting method (56-59) is equal to 6 or 7.

    DETEC_BY= 168 PREVIOUS= 091 184 168


>>>> EDIT COMPLETED; READ & CHECKED:   1458 records
```