

# Ruggedized Handheld Computers in Biological Research

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# Why PDA / Handhelds?

- Automation of repetitive observational tasks
  - Replacement of paper log notebooks?
  - Increase accuracy of reporting tasks
  - Reduce translational errors from traditional paper journals to various electronic forms
  - Save time
- Innovative research tools
  - Handheld (PDA) computing form factor has many advantages
    - Easier travel (customs)
    - Small size / low weight
  - Integration of digital data from various pieces of technology (immersion monitors, PDA, GPS) centered on laptop as analysis/reporting tool
  - Integration of “interesting” peripherals
    - Barcode scanning, GPS loggers, other data collection devices



# Symbol 2700 in the Galapagos



Mark Westbrock

# Jeff's Goals

- Production of a “General Purpose” PDA Database/Logging Program for use in classroom and or research scenarios
- Partnership with ISSC R&D Group expertise/resources to specific research domain issues
- Development of domain specific tools as “Proof of Concept”
- Maybe? Expand University's Expertise in innovative/novel technology and applications

# PDA Use History

- PDA first suggested by D Anderson in 1997 as a way of automating and standardizing logs
- WinCE platform suggested by a Computer Science undergraduate, Chris Marts
- Investigation of PalmOS vs WinCE (1998)
- First PDA census program 1998-99
  - Everex Freestyle-66 MHz processor and 8 MB of RAM
- PDA proved difficult to interface to satellite phones—needed a laptop in the field

# Problems with Developing for PDA

- Small memory
- No true mass storage options
- Lack of non-volatile storage
- Battery life issues
- Small screen size
- Transfer of data from PDA to other platforms can be challenging
- WinCE/PocketPC stripped of some very useful classes (programmer's problem)



# Advantages of PDA

- Small size
  - Convenient, portable
  - Unobtrusive
  - Can be worn on body
- Low power consumption
  - (especially the Symbol 2700)
- High availability
- Durability
- Pen/Touchscreen interface

# Census / Birdtrack

- Albatross Census; (1998-present)
  - Based on WinCE 2.0 VC++ platform
  - Everex Freestyle/Casiopeia E11 handheld
  - Observer log in
  - Band number typed on keypad
  - Lookup on limited database of existing birds
  - New data logged about a particular bird
  - Many iterations/variants have been used
    - Foot damage, blood samples, sex confirmation, last seen

# Screen Shots: The Census Program

Emphasis on Speed and Simplicity

Start 12:42p ok

Census II

Obsvr Initials

Select Db

Hash Size

Quit Begin

Start 12:46p ok

Off

1	2	3
4	5	6
7	8	9
BS	0	C

OK

Start 12:45p ok

Cancel

Band: 90005 Study: dem

Banded: 92 Banded as: j

Last seen:

Note:

Sex of 90005 is UNKNOWN

MALE FEMALE

ACCEPT

# Bird Carried GPS Logger

- GPS movement downloader (2002)
  - Downloads data from a bird GPS “backpack”
  - Can also be used to download data from bird “Immersion Monitors”
  - Supports simple serial (RS-232) standard download with hardware handshaking





# Behavior Logging

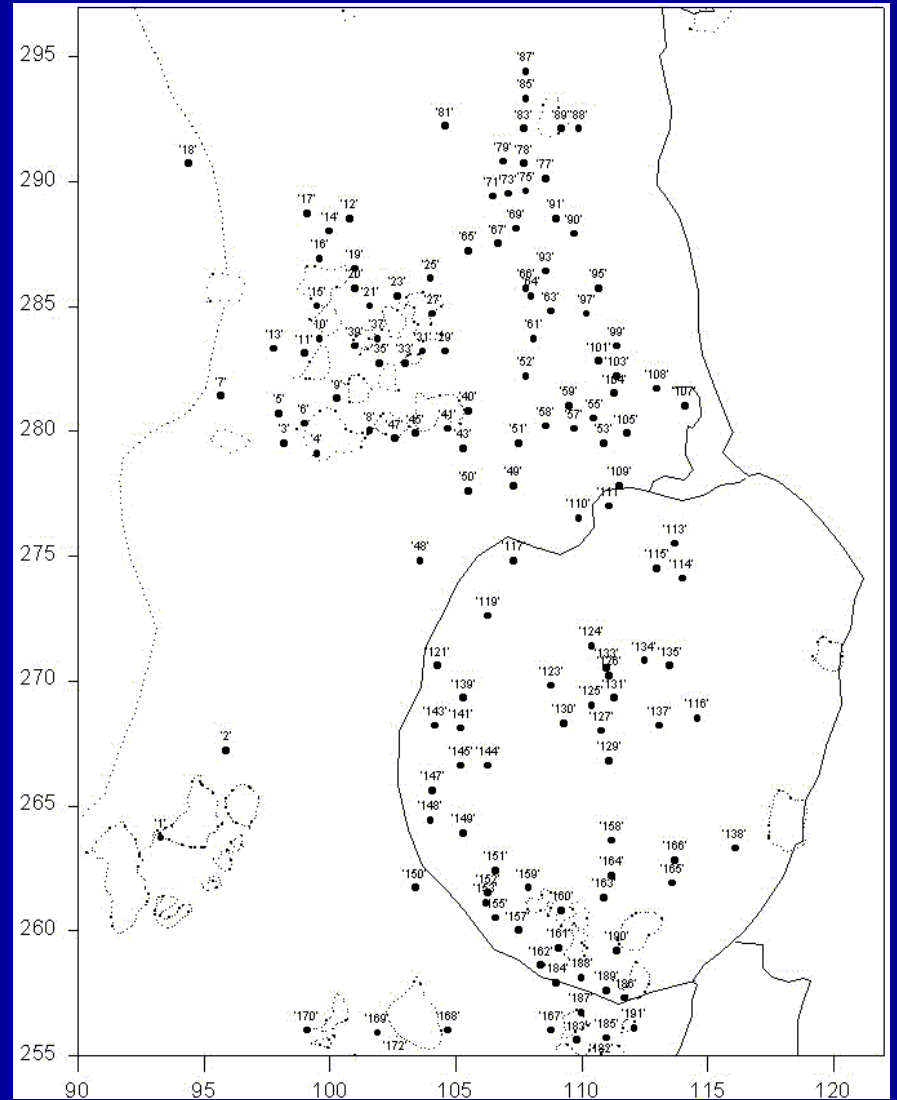
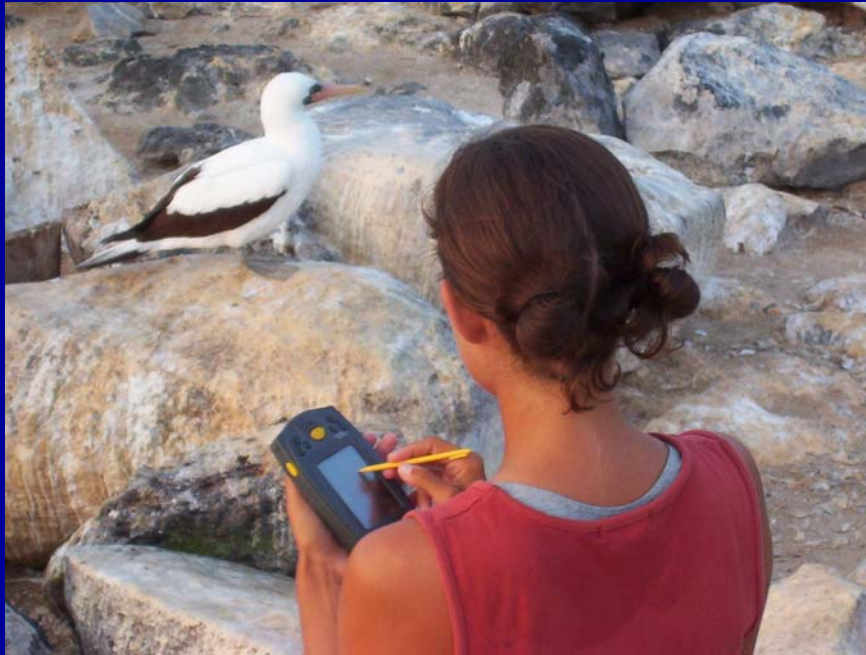
- Nest Logger I; (2000-2002)
  - Logging of time and actions by a particular nest/family group
  - Simple, fixed pushbutton interface
  - Logging to plain-text date-based files
  - The basis for a new “generic” Ethogram program currently in writing stages for Wm. Conner

# Elaine Porter using B-Logger

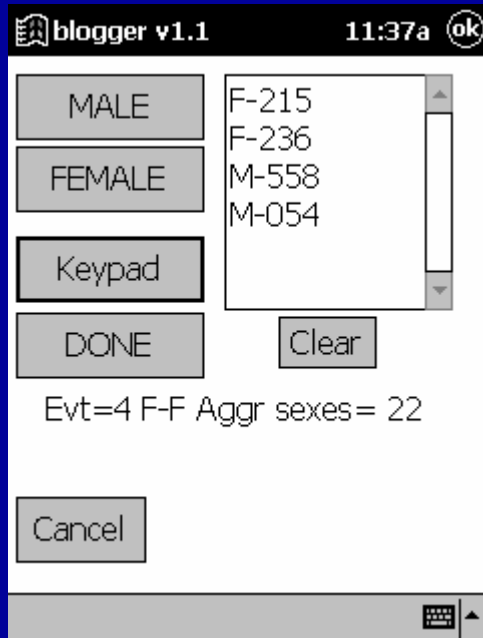
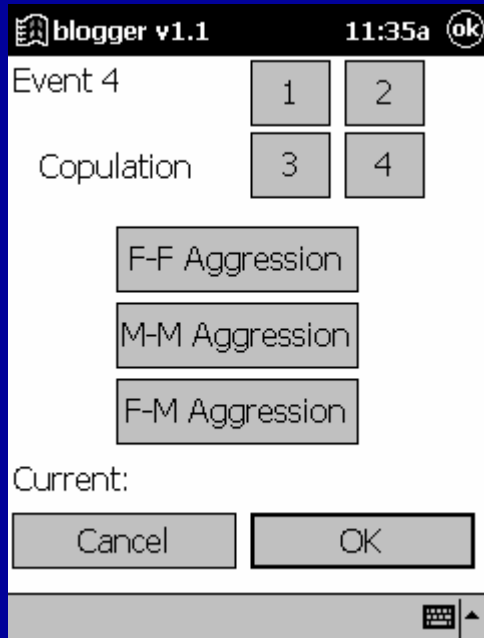
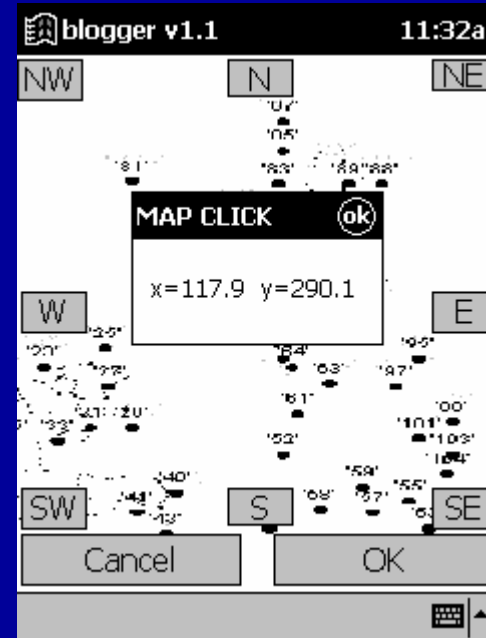
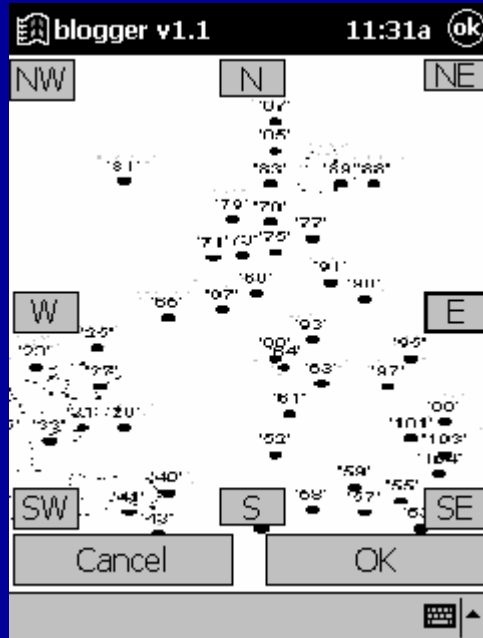
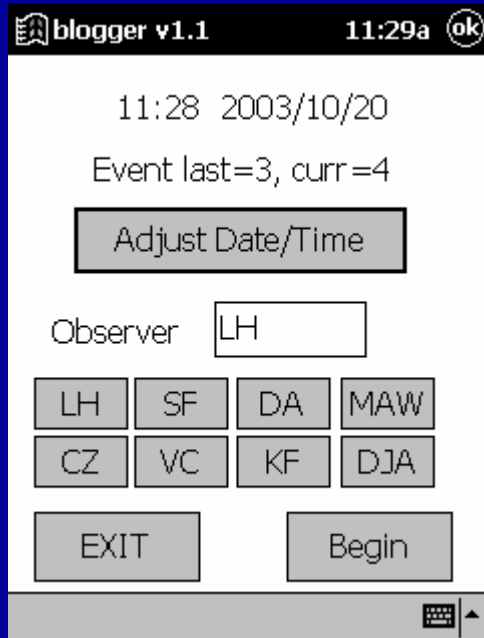


# B-Logger

- B-LOGGER I and II; (2002-2003)
  - Based on Symbol Systems PDA platform (thanks to technical and financial support from J. Dominick, A. Bishop, and P. Escott)
  - Map-based Behavior logger (thanks C. Fulp for advice/support on graphics)
  - Screen gesture selects a location on a map accurate to 0.5m or less, judged by accurate listings of hundreds of nest sites.
  - Band numbers entered via keypad or laser barcode reader (thanks to M. Johnson and R. McCartney)
  - Excellent confidence going into the field because of battery life/duty cycle research performed by MJ and RM.
  - Subsequent release II in 2003 (for E Porter) supports larger maps and better accuracy, variable screen origin, and zoom-in/zoom-out capability.







# Classroom EthoLog

## Ethogram logger concept, Bill Conner

- Allows user to log behavioral events from a list of choices
- Allows user to optionally identify the “actor(s)”
- Allows user to add new behaviors to the predefined list of behavioral events
- Proof of concept established by Anderson’s Nest Logger program
- Prototype was successfully piloted summer session II by WFU students



# Ethogram Button Wizard

The screenshot shows the 'Ethogram Setup Wizard' window with a menu bar containing 'File' and 'Help'. The interface is divided into four main sections: 'Form', 'Page', 'Preview', and 'Send'.

- Form:** Contains buttons for 'Open from Desktop' and 'Save to Desktop'. It has input fields for 'Columns:' (value: 2) and 'Rows:' (value: 5). A note states: 'Note: The total number of buttons per page may not exceed 18'. There is also an input field for 'Pages:' (value: 1).
- Page:** Features a 'Page Select:' dropdown menu with 'Page 1' selected. Below it is a large empty text box. To the right, instructions read: 'Insert the name for the button in the text field and click the check box to set the button as active or inactive'. A table of 10 rows and 2 columns is shown, with the first four rows containing 'Eat', 'Drink', 'Read', and 'Sleep' respectively, each with a checked checkbox. A 'Check All' button is at the bottom.
- Preview:** Displays a 2x2 grid of buttons labeled 'Eat', 'Drink', 'Read', and 'Sleep'.
- Send:** Includes instructions: 'Plug in your Pocket PC and hit the connect button'. It has a 'Connect' button, a file explorer showing '\My Documents\' with an empty folder, an 'Add New Folder' button, a 'File Name:' field containing 'etho.ini', and a 'Send to Pocket PC' button.

Developed by Michael Swofford



**Start** 1:03p

Ethogram Logger 1

10/20/03 1:03:54 PM

Observer

Beginning Seq #

**Configuration** 1:05p

observer initials

sequence num

data directory

number of behavior pages

page rows  columns

**Start** 1:07p

Time(13:7:24)

<input type="button" value="M ant con"/>	<input type="button" value="F ant con"/>
<input type="button" value="M ant fen"/>	<input type="button" value="F ant fen"/>
<input type="button" value="M bite"/>	<input type="button" value="F bite"/>
<input type="button" value="M follow"/>	<input type="button" value="F follow"/>
<input type="button" value="M groom"/>	<input type="button" value="F groom"/>
<input type="button" value="M kick"/>	<input type="button" value="F kick"/>
<input type="button" value="M moves"/>	<input type="button" value="F moves"/>

pAct() pTime(0:0:0)

Event # 1

**Start** 1:08p

Time(13:8:36)

<input type="button" value="M palpate"/>	<input type="button" value="F palpate"/>
<input type="button" value="M pause"/>	<input type="button" value="F pause"/>
<input type="button" value="M roc bod"/>	<input type="button" value="F roc bod"/>
<input type="button" value="M withdra"/>	<input type="button" value="F withdra"/>
<input type="button" value="F mount"/>	<input type="button" value="M agg son"/>
<input type="button" value="M cal son"/>	<input type="button" value="M push ba"/>
<input type="button" value="M turns"/>	

pAct() pTime(0:0:0)

Event # 1

**Define Actors** 1:09p

A	B	C	D	E	F	G
H	I	J	K	L	M	N
O	P	Q	R	S	T	U
V	W	X	Y	Z	+	-
0	1	2	3	4	5	6
7	8	9	*	.	,	?

# Results

- Confidence:
  - PDAs are rugged enough for field use
  - battery life sufficient for frequent field activation of Barcode scans
  - Flexible enough for Domain specific application
- Time saved:
  - Massive amounts of time saved by having logs in electronic form
  - Standardization of logging formats
  - Frequent repetitive reliable observations now possible
- Improved Accuracy

# Valuable Code Re-use

- Keypad
- Barcode
- Map
- Resource/INI file
- Log file
- Serial communication

# Remaining Goals

- Integration of GPS
  - To supply accurate Time, Date, Lat, Long, Elevation coords.
  - As context source for Map object
- Development of “Wizards” to customize Ethogram program suite
  - Valuable concept for any Database tool
- Development of a Biological/Archeological collection tool (application: Botanical/Herbarium)
- Generic database/logger idea?
  - Is a useful implementation possible or is the PDA too “brittle” of a platform?

# Future Directions

- Wireless networks
  - Enhancement of communication
  - Client/Server model
  - “Uplink” of field data
- GPS awareness
  - positional context sensitive database
  - Ability to use PDA as a mapping device
- Tablet form-factor computing
  - PDA is too small for some aspects of computing
  - Integration with newer communication standards

# Client/Server Computing

Problem: Databases will contain too much data to be hosted on handheld computers.

Solution: Bring a database server to the field and have PDAs function as clients.



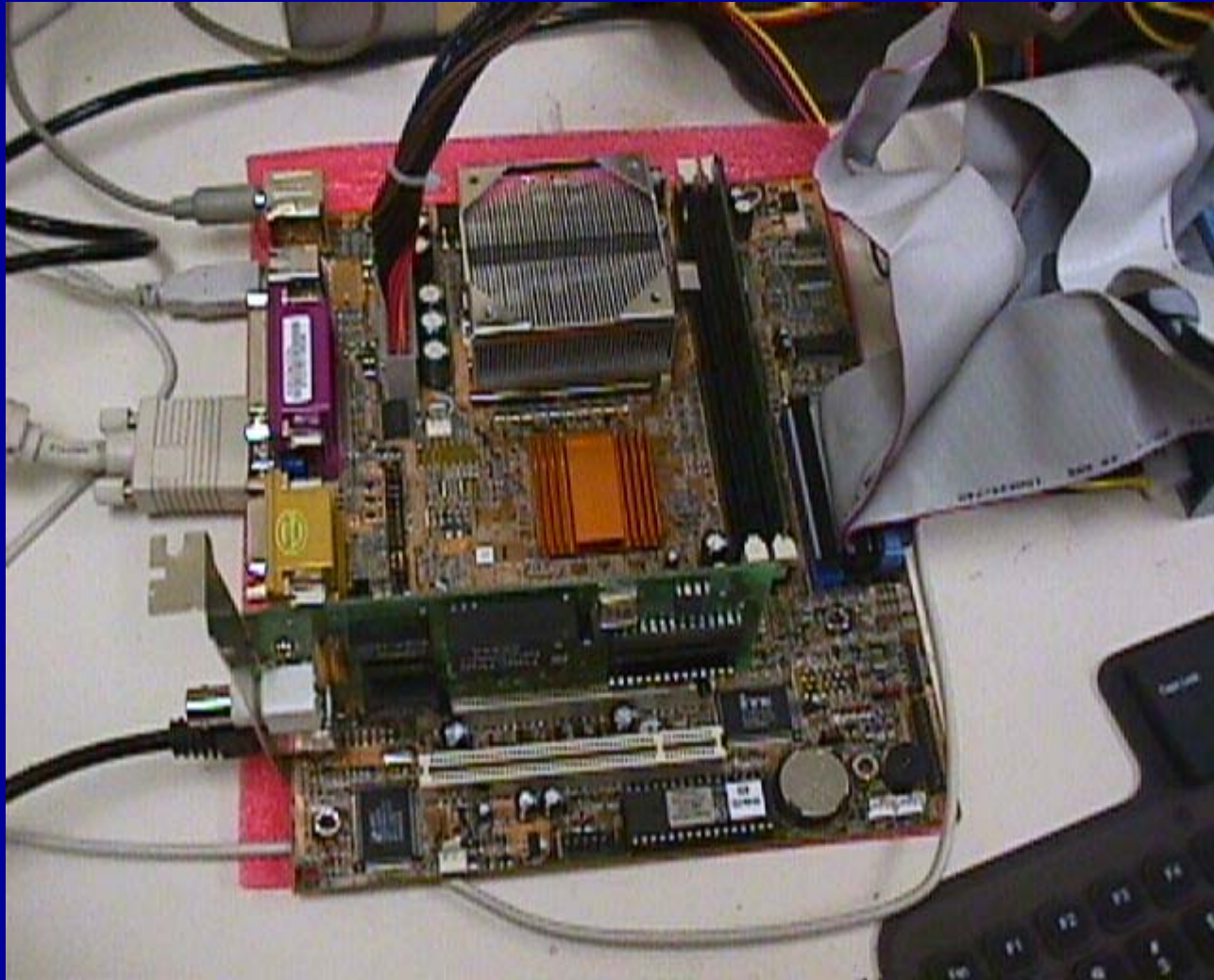
# Requirements

- Headless – requires no monitor keyboard or mouse.
- Network – wireless 802.11x + Cat 5 Ethernet
- Removable solid-state mass storage
- Low power consumption
- Interconnectivity to PocketPC & Windows Platforms (network + USB hotsync)
- Database hosting capabilities

# Using an Old Sun Sparc Station



# Fanless Motherboard for Field Station



# Compact Flash as Mass Storage Device





