B A R R I E R   I S L A N D   C E N T E R
Brevard County Environmentally Endangered Lands Program

A NON-INVASIVE APPROACH TO DOCUMENTING HUMAN INTERACTIONS WITH NESTING SEA TURTLES

SEA TURTLE GRANT # 11-011R

PRINCIPLE INVESTIGATOR: RAYMOND MOJICA JR.

8385 S. Hwy A1A Melbourne Beach, FL 32951 • telephone: 321.723.3556 • fax: 321.952.3207 •
www.barrierislandcenter.com

A non-invasive approach to documenting human interactions with nesting sea turtles

Raymond Mojica Jr., James Schubert, and Brittany Rainbow

Brevard County Environmentally Endangered Lands Program

Barrier Island Center

8385 S. Hwy A1A Melbourne Beach, Fl 32951

Abstract

During the summer of 2011 light sensitive cameras and GPS mapping were used to document interactions between nesting sea turtles and humans over a 57 day period within the Archie Carr Refuge. The study mapped over 230 turtle tracks on the beach with only 29% resulting in nests. The camera recorded an additional 355 instances where turtles did not emerge from the surf or did not proceed far enough up the beach to be mapped. During the study period the cameras detected a total of 46 instances where humans appear to have interrupted nesting which accounted for less than 9% of the total non-nesting events documented.

Introduction

The Archie Carr Refuge (Refuge) on the east coast of Florida hosts the highest nesting density of loggerhead sea turtles (*Caretta caretta*) in the western hemisphere and the most significant area for green sea turtle (*Chelonia mydas*) nesting in North America. The 20 miles stretch of beach that make up the Refuge is a mixture of conservation land and private properties and is served by the Barrier Island Center (Center), an environmental interpretation facility located in the heart of the Refuge. Each summer, during the months of June and July the Barrier Island Center hosts guided sea turtle walks with its partner the Sea Turtle Conservancy.

Though guided turtle walks are the preferred method for individuals to view nesting sea turtles, it is undeniable that unguided, unauthorized walks are common. Within the Brevard County portion of the Refuge there are 36 public access points, 295 private access points (both private homes and neighborhood accesses) and 27 illegal access points. Though most of the public access points are technically closed at sunset, few are gated and enforcement is spotty or non-existent. Reports of unguided individuals and groups inappropriately interacting with sea turtles either by direct harassment or the use of artificial lights and/or cameras are common.

Quantifying the temporal and spatial extent of inappropriate contact with nesting sea turtles is very difficult given the size of the refuge, the numerous access points and the darkness. Without a way to document and quantify these events there has been no way to know what percentage of false crawls are caused by humans on the beach. During the summer of 2010 the use of long exposures, high ISO cameras to capture bright, full color images of the sea turtles and humans on the beach was pioneered at the Center and a protocol was developed to utilize this technique to document human-sea turtle interactions on a 1,000 foot section of beach adjacent to the Center.

Methods

This study area is defined by the 1,000 front feet of beach adjacent to the Center. The Center, which is managed by the Brevard County Environmentally Endangered Lands Program, hosts guided turtle walks during June and July and is located adjacent to the un-gated public beach access of Bonsteel park. An overlook located at the Center was used to deploy the cameras which were affixed using cable locks and oriented to point north and south, covering the entire 1,000 feet of beach (Figure 1).

Figure 1. Study Location

The cameras used for the study included 2 Canon T1i which were modified to accept a high capacity LiPo battery and equipped with an interval timer. Each camera was set to the maximum ISO value of 12,800 and set to capture an image every 30 seconds with an exposure which varied from 1 -3 seconds depending on the phase of the moon. In addition, a single Canon 5D, with a maximum ISO of 25,600 was deployed facing north to determine if the higher ISO values resulted in significant reduction in shutter speeds and thereby image quality. The cameras were deployed from sunset to sunrise and captured approximately 1,200 images per night. The time of each photo was retrievable from each images Exif data and the resulting images were then “stitched” together to create time lapsed movies of each nights activities.

Following the retrieval of the cameras each morning a Trimble Pro XR GPS was used to map every turtle track from the previous night. In addition to the location data, the species of turtle, width of the track and outcome of the emergence were recorded. The GPS data was then combined with the photographic information into a database and the outcomes of individual events were recorded.

Results

The cameras were deployed for a total of 57 nights from June 11 through August 7th, 2011. Both the north and south facing cameras obtained useable images 82% of the time, information from only one direction was obtained 14% of the time and neither camera functioned the remaining 4% (Figure 2). Though the higher ISO afforded by the Canon 5D allowed for crisper images when photographing moving subjects due to the lower shutter speed, the detail was not so great as to justify the higher price per camera.

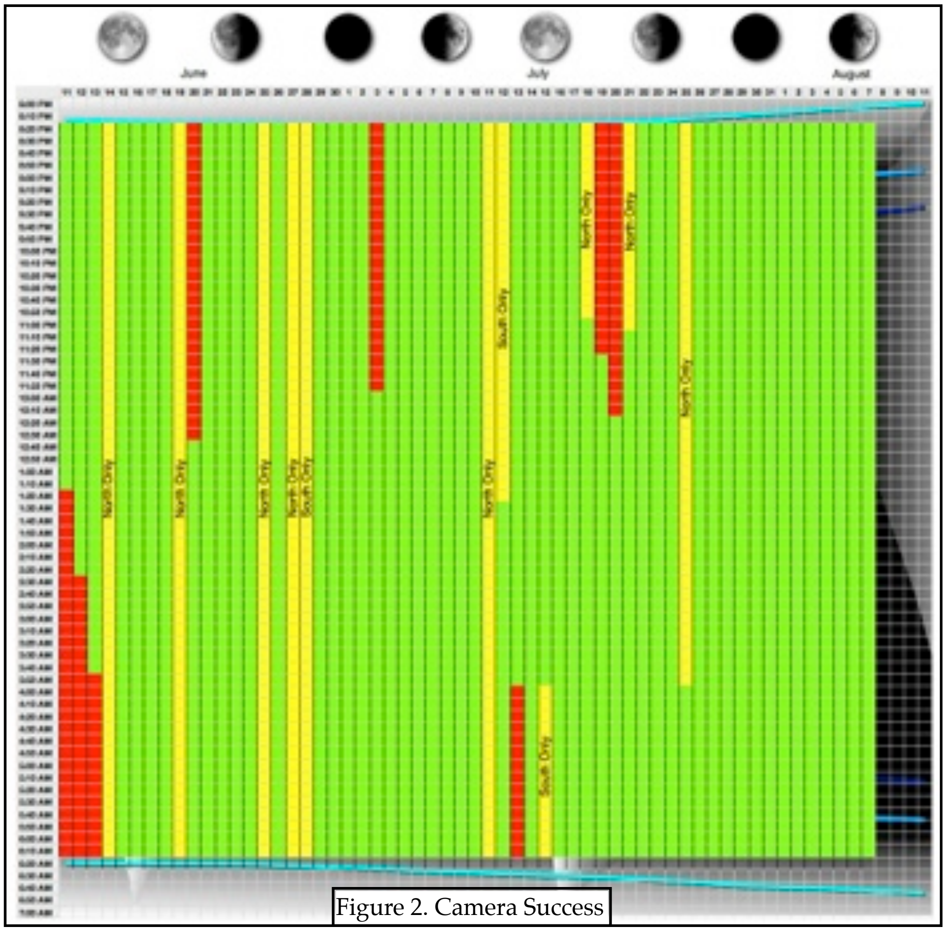


Figure 2. Camera Success

A total of 230 turtles were mapped within the study area and detected by the cameras with only 29% of these resulting in a nest. In addition, the cameras captured 355 turtles which either did not emerge from the surf or did not move far enough up the beach to leave a track that could be mapped. There is no way to tell if the turtles that did not emerge onto the beach did not emerge later or at some other location.

The cameras recorded a total of 46 instances where turtles appear to have been disturbed by humans. Guided sea turtle walks accounted for only 4 of these events while 23 were the result of humans not associated with the guided turtle walks. The latter events included individuals either swimming, fishing and/or walking on the beach presumably in search of turtles. On one occasion, two Brevard County Sheriffs can be seen approaching multiple turtles with white flash lights, directly causing one to false crawl. In addition, there were 19 instances of University of Central Florida researchers, riding ATVs, seeming to disturb turtles. It should be noted however that directly attributing the turtles behavior to the humans presence is difficult. The brightness of the images belies the fact that to the humans and the turtles it is very dark and it is conceivable that they may not have been aware of each others presence in every case. Even assuming that the humans were responsible for each of the 46 perceived disturbances, there were an additional 472 instances of turtles either not emerging from the surf or abandoning a nesting attempt when no humans or other discernible threat was present.

The coupling of the GPS and photographic data sets also provided useful information about the times of night and duration of the nesting process. There were 30 loggerhead and 20 green turtles with enough information to graph the nesting event. A graph was developed which displayed the relative brightness of the lunar phase over the duration of the study and the beginning and end times of each nesting event were graphed onto this.

For the loggerheads the entire nesting process took an average of 1 hour and 42 minutes to complete with a maximum of 3 hours and 18 minutes and a minimum of 38 minutes (Figure 3). The loggerheads do not appear to have a preference with regards to lunar phase, nesting evenly on light and darks times of the night and/or month.

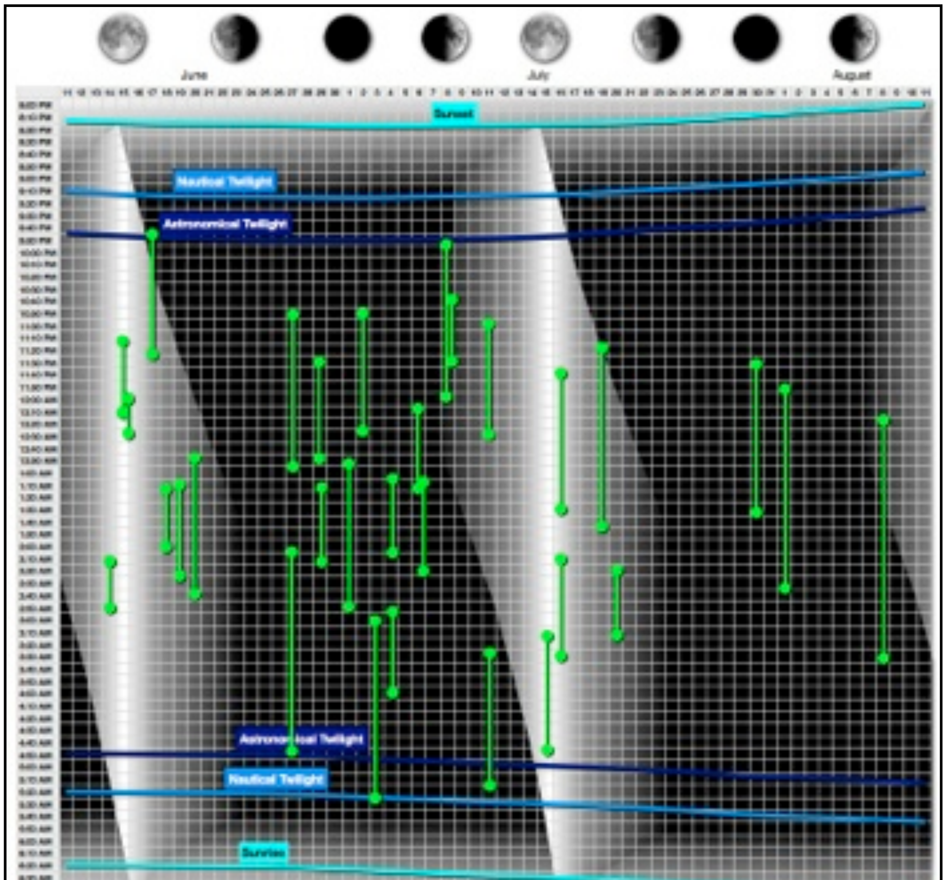


Figure 3. Loggerhead nesting durations

Green turtles took an average of 2 hours and 24 minutes to complete the nesting process with a maximum of 3 hours and 36 minutes and a minimum of 50 minutes. Interestingly the green turtles appear to prefer the darker periods of the month with only 2 nesting within 3 days of the full moon (Figure 4).

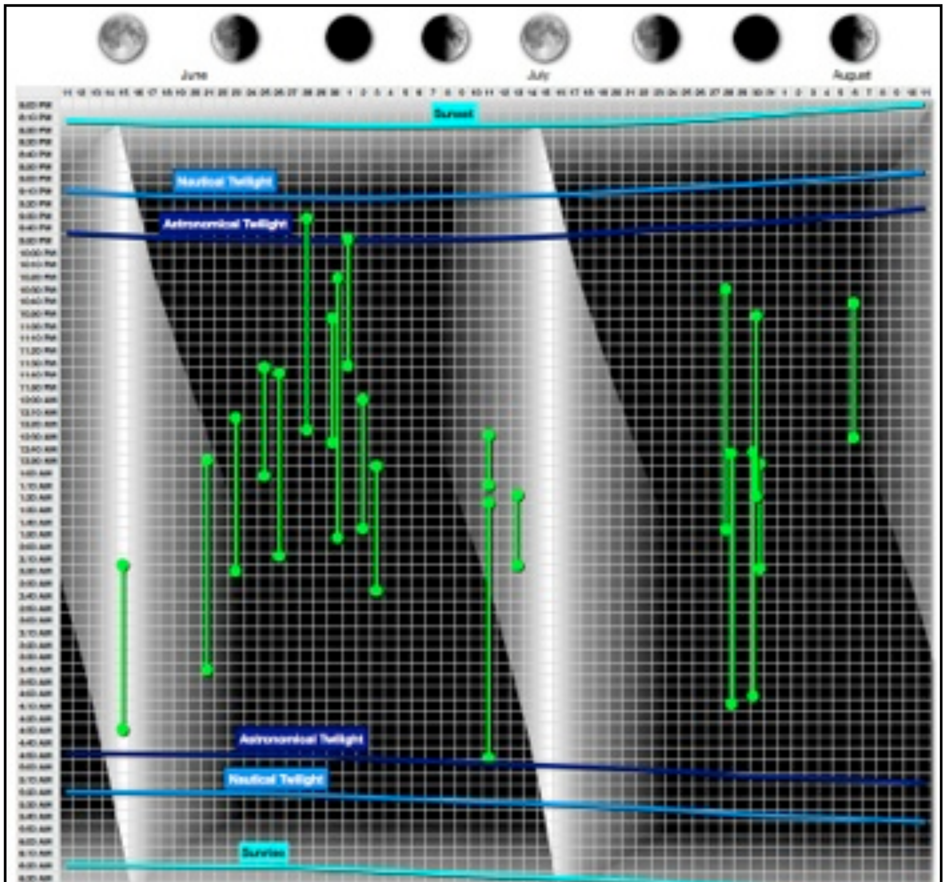


Figure 4. Green nesting durations

Discussion

For the cost of approximately $1,000 per camera, the methods employed for this study have proven to be an inexpensive tool for monitoring sea turtle behavior as well as the activities of humans. The results show that though humans are likely causing at least some of the false crawls and abandoned nesting attempts there are many more that occur for no apparent reason. It should be mentioned that the brightness and clarity of the images do not accurately reflect what the humans and turtles are seeing and interpretation of causality should bear that in mind.

The study has shown that there are a great number of people on the beach at night that are not associated with guided turtle walks and that many are engaged in activities that are illegal including directly approaching turtles and the use of artificial lights. Educating the public on their potential impact to nesting turtles and expanding access to permitted guided turtles walks are essential to reducing the number of false crawls caused by humans.

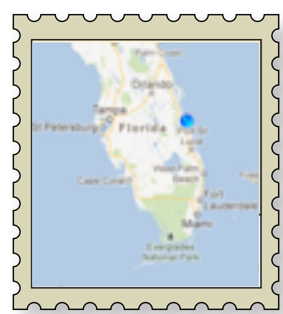
Brevard County Board of County Commissioners
Parks & Recreation Department
Environmentally Endangered Lands Program

Full Color Night Vision Sea Turtle Photography Guidelines

This image was taken at 11:30 pm on a moonless night with no artificial light

A different kind of night-vision

During the summers of 2011 and 2012, researchers at the Barrier Island Center in Melbourne Beach, Florida began using a novel photographic technique to better understand the behavior of and threats to sea turtles nesting within the Archie Carr National Wildlife Refuge. This document seeks to provide guidance and instructions on how to duplicate these procedures elsewhere.



The basic premise of the procedure is to use a stock camera with a high ISO capability, coupled with an interval timer and high capacity battery to create time lapsed movies of the beach at night. The benefit to this method over standard night vision is that the images produced are full-color and are much more detailed.

Though the procedures detailed below can be adapted to other needs they lend themselves particularly well to the study of nesting sea turtles given that sea turtles are slow moving and the shutter speeds (from 1-3 seconds) are adequate to capture their movements. The camera used in this study, a Canon Rebel T1i, has a maximum ISO setting of 12,800. Though there are other cameras that have higher ISO settings and can therefore take shots with a shorter shutter speed (and capture the movement of faster moving animals for example) they tend to be considerably more expensive than the ~$500 T1i.

This document is organized into the following sections: **Equipment** (everything you will need to purchase and how it all goes together), **Settings** (how to set up the camera and controller), **Deployment** (setting up the system to collect images) and **Post Processing** (how to resize, store and convert the individual images to time-lapsed movies). We expect that other end users will modify these procedures to fit their own needs or to work with other cameras and that as technology evolves other solutions may present themselves. We look forward to your questions, comments, feedback and innovations.

Barrier Island Center, 8385 S Highway A1A, Melbourne Beach, FL 32951 Phone 321-723-3556

raymond.mojica@brevardparks.com


EQUIPMENT

Table 1 lists all of the equipment that you will need to duplicate our work using a single camera. To add multiple cameras each of the items, with the exception of the battery charger, will need to be duplicated. The total costs for all of the equipment is approximately $1,150 US. You may be able to find some of the items cheaper on ebay (the lens for example) but *caveat emptor.*

Before we begin a little modification is required...

Most of the equipment can be used as-is out of the box. The first thing to do is to drill a hole in the Pelican case and fit the UV filter into it as a window using silicon. Next we will need to modify the DC Coupler so it can be connected to the LiPo battery, don't be afraid. The DC coupler is made so that you can plug your camera into a wall outlet but we will be making some modifications/ additions so that the battery can be hooked up instead. When you purchase the battery it comes with a generic connection point and a set of adapters that will attach to multiple connector types. One of these female adapters has a square hole for the positive terminal and a sort of barn door shape for the negative, this is the one that we will be using (Fig. 1). The next thing that we will need to do is modify the DC Coupler so that we can plug it into the battery. To do this we will need to crack open the coupler and solder on the male counterpart to the connector on the battery. You can easily pick up one of the appropriate male connectors (Fig. 2) at a Radio Shack, an electronics store or your local hobby shop, be sure to bring the female connector (or the entire battery) with you to the shop to ensure you purchase the right one. On the side of the DC coupler is a small opening where you would connect your wall plug and we will need to drill a small hole just below this to pass the wires through (Fig. 3). If you feel uncomfortable doing this type of thing find a friend, colleague or local electrician to help. With the hole drilled and the DC Coupler cracked open we will solder the positive wire (the red one) to the right-most of the three pins and the negative wire (the black one) to the remaining two pins (Fig. 4). If the wires that came on your male adapter are not long enough you may need to splice in some longer sections of the same grade (and color) wire so that you have room within the pelican case to freely move the battery. The assembled coupler and the final finished Battery-Connector-Coupler set-up should look like figure 5.

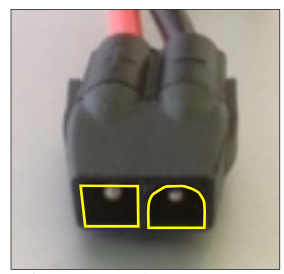


Fig 1. Female connector

Fig 2. Male connector

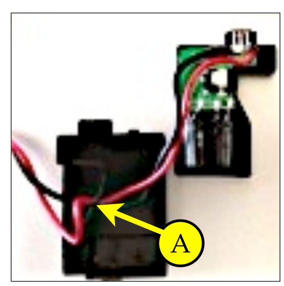


Fig 3. Drill hole location

Fig 4. Solder points

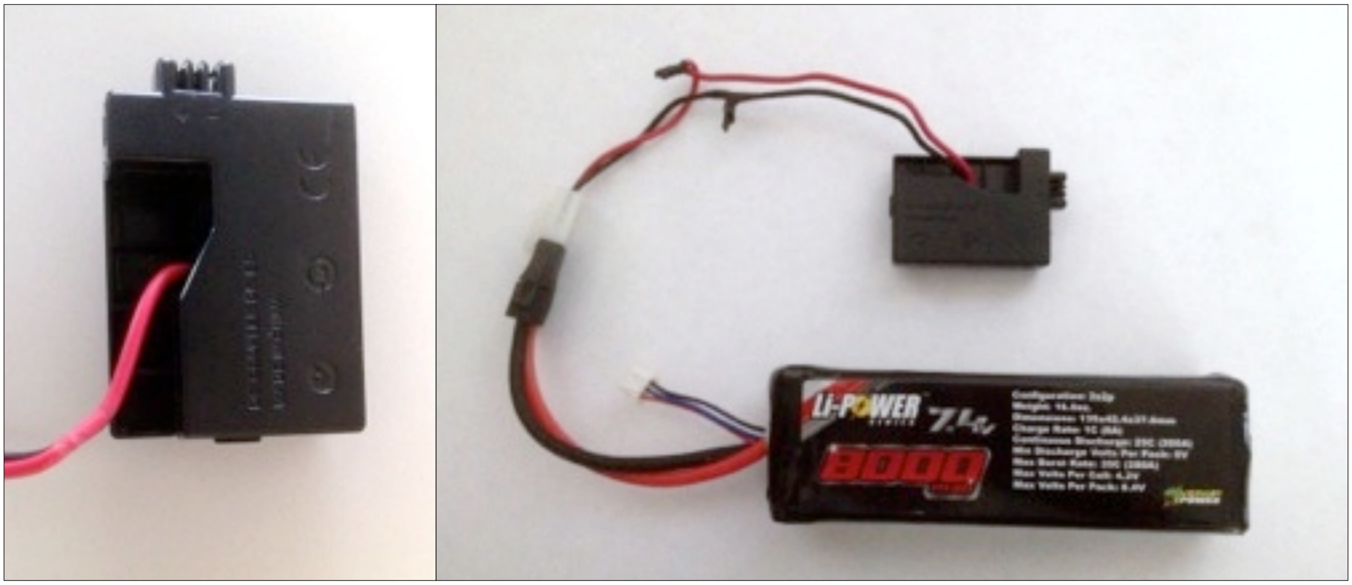
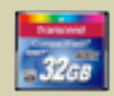
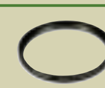


Fig 5. The assembled Coupler (left) and the battery-connector-coupler set-up (right)

Fig 6. The complete "device"

Fig 7. In the pelican case (left) and all closed up (right). Note that you will need to remove and trim the foam inside the pelican case to accommodate the camera and other components.

Table 1. Equipment

Equipment	Explanation	Approximate Cost	
Canon T1-i (or equivalent) body	*The camera that you will use needs to have an ISO setting of 12,800 or higher in order to take an image on a new moon night with a reasonable shutter speed of less than 3 second.*	*~$500.00*	
Canon EF 50 mm f/1.4 Lens	*This lens is sufficient for unmanned applications where you want to capture as large an area as possible. Telephoto lenses can also be used but require that the camera be manned in order to capture activity.*	*~$360.00*	
Canon DR-E5 DC coupler	*This is a DC coupler that slides into the battery compartment and will be attached the LiPo battery. An appropriate battery connection will be adapted to the coupler.*	*~$23.00*	
32 GB CF flash memory card	*Depending on the camera settings (image dimensions, quality etc.) you will need a card large enough to record for the duration of your shoot. The interval between photos (we used 30 seconds) will also obviously factor into the size of the card you will need*	*~$50.00*	
Venom LiPo 7.4v 8,000 MAH battery	*This is a battery used to power radio controlled cars and the like. It has sufficient power to run the camera for up to 24 hours.*	*$70.00*	
Sky Charger B6AC	*A trickle charger for safely charging the LiPo battery*	*$60.00*	
Aputure Timer Camera Remote	*Used to set the interval between photos*	*$35.00*	
Pelican Pelicase 1200	*To house the camera, battery and camera remote. A 3" hole will need to be cut through the side of the case and fitted with a UV filter.*	*$40.00*	
A 3" wide UV Protection Filter	*This filter will be silicone sealed into the hole drilled into the pelican case as a window*	*$5.00*	

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SETTINGS

Camera Settings

The instructions here are specific to the Canon T1i but will be very similar to those of the T2i and T3i.

- **Set the auto power off feature to off.** Press Menu, fifth tab over, at the top.
- **Set the ISO value to H (12,800).** The ISO button is located just behind the shutter release button.
- **Disable Flash firing.** Press Menu, first tab, scroll to bottom set to disable.
- **Set file numbering to continuous.** This will ensure that images will be numbered in the order in which they were taken. Press Menu, fifth tab over, second from the top.
- **Set LCD auto off to Enable.** Press Menu, fifth tab over, fifth from the top.
- **Be sure the date and time are set correctly including AM and PM.** There will be data associated with each image file that will help you if you wish to determine what time each image was taken. Press Menu, sixth tab over, second from the top.
- **The camera should be set to Manual.** Located at the top of the camera near the on/off switch.
- **If the lens is an autofocus lens it must also be set to manual.**
- **The lens should be set to f 1.4 and focused on infinity.** Lenses vary but this is usually accomplished by rotating a ring on the lens itself.

Controller (Timer) Settings

There are several manufacturers of the camera timers but they all work pretty much the same. Make sure you purchase one that will work with your camera (i.e. has the proper connector).

- **If there is a Delay setting be sure it is set to 00:00'00".** This is the setting that tells your camera how long to wait before taking the first picture.
- **Set the Interval to whatever setting you need.** We used 30 seconds so in our case our interval was set to 00:00'30". You can set it to shorter intervals but beware your card will fill up quickly, depending on its size. An interval of 6 seconds is a nice compromise and will produce more fluid movies.
- **If there is a Number setting (N) set it to null.** This tells the device how many pictures to take before it turns itself off, ours is set to --.
- **If there is a Long setting set it to 00:00'00".** This is a way to set how long to keep the shutter open but we will be accomplishing that in another way.

DEPLOYMENT

We deployed our cameras every night in June and July, setting the cameras out around 9:00 each night and retrieving them around 7:00 each morning.

1. Charge the Battery (this takes about 20-30 minutes so do this before you plan on deploying the camera).
    1.1. The battery has two connections, the female one that connects to the DC Coupler (Fig. 1) and another smaller white female connector with three openings. The latter ensures that the battery charges at the proper rate. The charger comes with a male adapter that is the same as one we attached to the DC Coupler (Fig. 2)
    1.2. Attach both connectors of the battery to the charger.

    1.3. Plug the charger into an outlet.
    1.4. Press the Yellow button once and it should read LiPo Balance 5.0A 7.4V(2S).

    1.5. Press and hold the green start button, screen will read battery check.
    1.6. Screen will prompt you to **Press Enter to confirm** so press the green button again and the battery will begin charging.
    1.7. Charger will beep when the battery is full and will display FULL.
    1.8. Unplug from the wall.
    1.9. Carefully detach the two connectors from the charger.
2. Insert the DC Coupler into the camera, there is a small rubber flap that allows the wires we soldered on to feed through.
3. Connect the battery to the Coupler.
4. Make sure that the camera lens and the inside and outside of the pelican case lenses are clean.

DEPLOYMENT continued

5. Attach the Timer controller to the port on the left side of the camera under the rubber terminal cover.
6. Ensure the camera is set to Manual.

7. Make sure that the focus is set to infinity and that the lens is set to f 1.4.

8. Before packing the camera into the pelican case you will need to take a test shot to properly set the shutter speed.
   8.1. Set the shutter speed to 1 second.
      8.1.1. When you turn on the camera you will see the shutter speed in the upper left hand corner of the display.

DEPLOYMENT continued

8.1.2. Adjustments to the shutter speed are made by spinning the thumb wheel behind the shutter release button.

8.1.3. Rotate the thumb wheel until the shutter speed reads 1”.

8.1.4. Take a photo, if the photo is too light you’ll need to reduce the shutter speed. If too dark you will need to increase it.

9. Once you have the desired shutter speed, pack the camera into the pelican case so the lens is flush with the window.

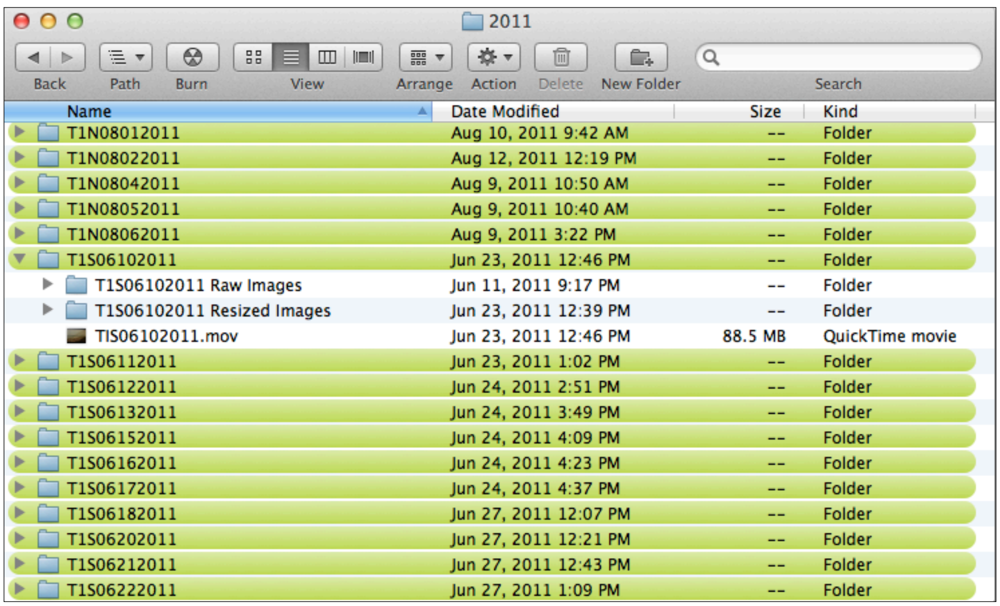
10. Make sure that the camera is on and none of the other lens settings have shifted.
11. Press the Start/Stop button on the interval timer to begin the process.
    11.1. You should see the numbers on the timer count down.
    11.2. A few seconds before it reaches zero it should light up and at zero it should trigger a shutter release and begin counting down again.
12. Close up the case.
13. Place the case in the desired location and secure it. We utilized a simple wooden frame that the pelican case sat in mounted to an observation deck to ensure that the view was consistent from night to night. We then used a bungie cord to hold it tight to the rail and a bicycle cable and lock wrapped around the deck and attached to the padlock holes on the pelican case to prevent theft.

POST PROCESSING

If you deploy your camera from 9:00 pm until 7:00 am and take a photo every 30 second you will amass about 1,200 images per night. We chose to take high resolution images with a pixel dimension of 2352 pixels wide by 1568 pixels high so that we might zoom into particularly interesting images. The downside to this is that each image was approximately 1.1 MB in size. Multiply that by 1,200 images per night over 60 nights times 2 cameras and you quickly realize that you need enough hard drive space to store them all. We chose to purchase a $200, 1 TB (terabyte) external hard drive and after 2 seasons we still have some room to spare.

The first challenge was to come up with a file structure to keep all of the individual images organized. We went with a relatively simple method of creating a folder for each camera for each day. For example the folder labeled "T1S06102011" would house everything from the Canon T1i that was facing South (as opposed to T1N that was, wait for it, facing North). Within each of these folders we would create subfolders to house the Raw Images for that camera-night so there would be a folder entitled "T1S06102011 Raw Images" which would hold the full size original images.

We also wanted to also be able to "sew" the individual images together into time-lapsed movies but given their pixel dimensions and file size they would first need to be resized. So within each parent folder and in addition to the Raw Images folder there would be a folder labelled "T1N06102011 Resized Images" and any movies created from the resized images would have the same label.



Retrieving the Camera in the morning and transferring the images to the computer

1. Open up the Pelican Case and turn off the camera and hit the Start/Stop button on the timer.
2. Disconnect the battery and either charge it now or give yourself enough time to charge it before you deploy the camera that night. The battery and charger should not be left unattended if it can be avoided so plan on being there while it is charging. Improper charging can lead to fire and/or damage to the battery.
3. Remove the Compact flash card from the camera and place it in a card reader (this is preferable to connecting the camera directly to the computer).
4. Create a folder labelled as described above and within that folder create your Raw Images folder.
5. Drag the images from the CF Card to the Raw Images Folder

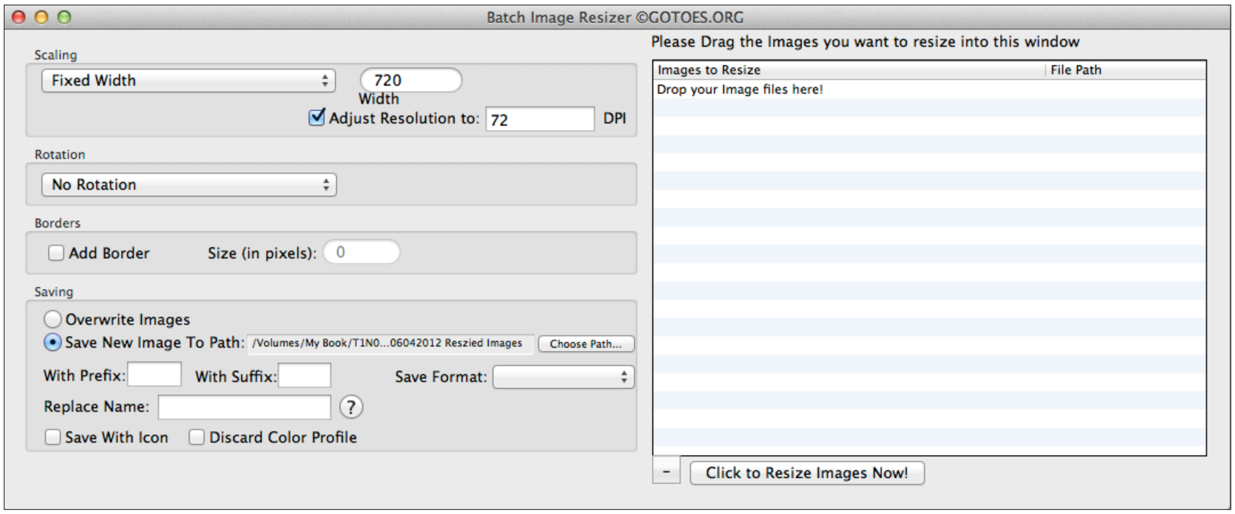
POST PROCESSING continued

Resizing the Raw Images

1. We use Macs and have found an application called BatchImageResizer which as the name suggests resizes images in batches. There are numerous Windows analogues that should be able to do the same thing.

2. Launch BatchImageResizer

3. We decided that we wanted our finished movies to be standard definition (SD) with a pixel dimension of 720 wide by 480 high. Since our Raw Images were so large we could at any point convert the Raw Images to



either of the HD resolutions of 1280x720 (720p) or 1920x1080 (1080p).

4. Under Scaling select the width of 720 (or 1280 or 1920 depending on what you want as your final size).

5. Under Saving choose the path that you want to save your converted images to, in this case it would be the Resized Images folder that you created within the parent folder for that camera-day.

6. Select all of your Raw Images for that camera-day and drag them into the open space on the right.

7. Click the Click to Resize Images Now button, it'll take a few minutes.

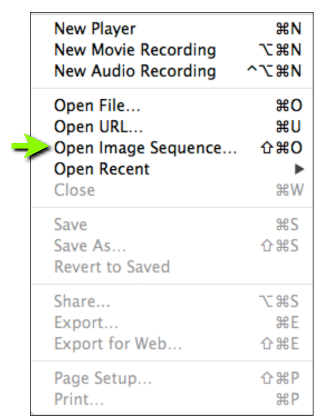
Creating your movie

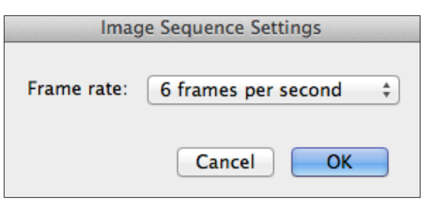
1. On the Mac we will be using Quicktime 7, which is the older version but still runs on any system up to and including 10.8 (Mountain Lion)

2. Launch Quicktime 7

3. Under the File Menu select Open Image Sequence.

4. Navigate to your Resized Images Folder and select the first image in the list and click Open





5. It will then ask you for a frame rate, we used 6 frames per second, click OK.

6. Once your movie is made Save As to the parent folder and name it as described so should the movie ever get separated from the folder it's name will refer to the date and camera it is from.

7. Don't forget to regularly back up your work!!!!!