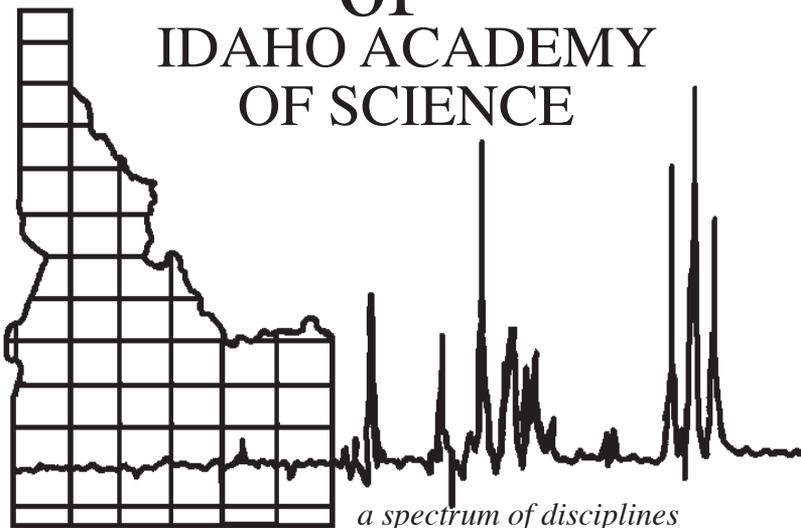


# JOURNAL of the IDAHO ACADEMY OF SCIENCE




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# THE JOURNAL OF THE IDAHO ACADEMY OF SCIENCE

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# FIRST RECORD OF WORMLIONS (DIPTERA: VERMILEONIDAE) IN IDAHO

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## ABSTRACT

Flies of the family Vermileonidae (Diptera) were recorded for the first time from Idaho. The predatory larvae construct pit traps in loose soils similar to those of antlions. *Vermileo opacus* (Coquillett) adults were reared from larvae collected at a site 16 km east of Boise, Ada County, Idaho. Twelve adults were reared from twenty-three larvae using three different diapause temperatures. This is one of two species recorded for the United States and represents a northern range extension for these relatively unknown flies.

**Key Words:** Vermileonidae, wormlions, *Vermileo opacus*, Idaho record, rearing

## INTRODUCTION

Flies of the family Vermileonidae are unique among Diptera in that the larvae construct pitfall traps, similar to those of antlions (Neuroptera, Myrmeleontidae), in order to capture prey. Their common name, wormlion, has been given to them because of this behavior.

Wormlions were once placed in the Family Rhagionidae, but Nagatomi (1977) gave them family status. The adults differ from the Rhagionidae in having the wings more narrowed at the base and in having apical spurs on the front tibiae (Borror et al., 1989). Griffiths (1994) established a new infraorder, Vermileonomorpha, for the family as no certain relationships with other Brachycera had been demonstrated. Worldwide, the Vermileonidae are known from seven genera and fifty-five species (Nagatomi et al., 1999). The family is distributed in southern Europe, the Middle East, Asia, North and South Africa, and North and Central America (Ludwig et al., 2001), but not Australia or South America (Nagatomi et al., 1999). *Vermileo opacus* is distributed in several western states of the United States, including California, Nevada, Utah, Colorado, New Mexico (Nagatomi et al., 1999), and now Idaho.

Wormlion adults are slender, almost hairless flies, with stylate antennae, subpetiolate abdomen, and slender legs. They have a life span of only two or three days, during which they feed on nectar and mate. The females deposit eggs just under the surface of the substrate in which the larvae live. Eclosion takes approximately one week (Teskey, 1981), but can vary depending on temperature (Hafez & El-Moursy, 1956). Newly hatched larvae are about 2 mm in length and 0.2 mm in diameter. Some species, when fully grown, can reach 20 mm in length and 2.5 mm in diameter (Ludwig et al., 2001). They have a small,

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almost completely retracted head capsule and an increasing taper posteriorly. Larvae construct pitfall traps by throwing substrate with their heads. Once the pit is complete the larvae position their anterior across the bottom of their pits, ventral surface up (dorsograde), at or just below the surface where they wait for prey. When prey falls into the pit, it is seized and immobilized by the larva, which consumes the prey's softer parts and then throws the carcass out of the pit. After about one year, the larvae pupate and about a month later the adults emerge. Wheeler (1930) devotes a chapter in his book, "Demons of the Dust," to the habits of this unusual predator.

The objective of this study was to search for Vermilionidae flies in southern Idaho, a state from which they have not been previously reported.

## METHODS

**Collection.** The short life span of the adults along with their inconspicuous form and behavior make them difficult to collect. My search, therefore, focused on the larvae, which are more easily found by looking for the pitfall traps in which they live. Larvae were collected from pits by excavating the substrate around and under the pit with a spoon or similar tool, then straining the substrate through a screen to isolate the larvae for identification, as pit-building antlions (Neuroptera: Myrmeleontidae) occupy the same habitat. Voucher specimens of larvae, pupae, and adults have been deposited in the Orma J. Smith Museum of Natural History, Albertson College of Idaho, Caldwell (ALBRCIDA) and the personal collection of Wade Petersen, McDonough, GA.

**Rearing.** Larvae were housed in the laboratory in small glass jars filled with the substrate from which they were collected. The substrate was dry, powdery soil with varying degrees of small pieces of organic matter. Larvae were fed three to four times weekly while active. Food consisted primarily of flour beetle larvae (*Tribolium*), but aphids and ants (species undetermined) were used when they were available during August and September of 1995. No liquids were provided to the larvae.

In order to increase the chances of rearing larvae for later identification, separate groups of larvae were subjected to three different temperature regimes to stimulate diapause. Selection into the regimes was based on inactivity. Those that were inactive by 4 October 1995 (n=8) were held at 15.5°C from 4 October 1995 through 29 February 1996. The remaining larvae that became inactive by 1 December 1995 (n=11) were held at 4.0°C from 1 December 1995 through 15 February 1996. Three larvae remained active after 1 December 1995 and were left at room temperature, approximately 21°C, for the entire study.

## RESULTS

**Collection.** Five locations in Southern Idaho were surveyed for larvae during July and August 1995 (Figure 1 and Table 1, Location Nos. 1-5). Larvae were found only at Location No. 3 where eight larvae were collected from the base of cliffs on 1 August 1995 and fifteen more from underneath a netleaf hackberry (*Celtis reticulata* Torr.) grove on 5 August 1995. These represent the first Idaho record for *Vermileo opacus* (Coquillett) and Vermilionidae, and extend the northern known distribution boundary approximately 500 km. Since the original survey was conducted, Vermilionidae larvae have been found at other sites (Figure 1 and Table 1, Location Nos. 6-10). These larvae were not reared or

identified to species.

Rearing: Two of the different diapause temperature regimes produced adults. The group held at 15.5°C produced one male and two females. Of the remaining specimens in this group two died and three remained as larvae the remainder of the study. The group held at 4°C produced five males and four females. The two remaining specimens in this group only developed into pupae.

Of the three specimens left at room temperature, the first stopped feeding at the end of November 1995 then fed two times in early April 1996 but did not develop further. The second stopped feeding at the end of January 1996 then fed one time in early May 1996, but did not develop further. The third stopped feeding in the middle of February 1996 then died. One specimen died shortly after the study began, and wasn't included in any one group.

## DISCUSSION

Collection: In the original survey, larvae were only found on east and north facing cliffs or under hackberry trees on an east facing slope. The search for larvae at Site 4 was conducted under the bridges on the Boise River. Sites 1, 2, and 5 were located on south facing cliffs and west facing slopes. It's possible that larvae were not found in the latter conditions because temperatures may get too high due to the aspect. Surveys of the same areas with focus on north and east aspects may prove more fruitful.

After the original survey, larvae were found on south and west facing aspects under cover from vegetation or boulders. Surveys of the original sites under heavily protected areas on west and south facing aspects may also prove more fruitful.

Rearing: Wheeler (1930) and Hafez & El-Moursy (1956) noted that *Vermileo* species they observed have a diapause in their life cycle. This study would suggest the *V. opacus* has an obligatory diapause as well, since none of the larvae that remained at room temperature for the entire study completed their life cycle. However, there have been no studies undertaken to discover the diapause details of any Vermileonidae species (Nagatomi et al 1999). Since the two lower diapause temperature regimes produced both males and females it appears that diapause temperature does not determine sex, at least with these two temperatures and this small population.

## ACKNOWLEDGEMENTS

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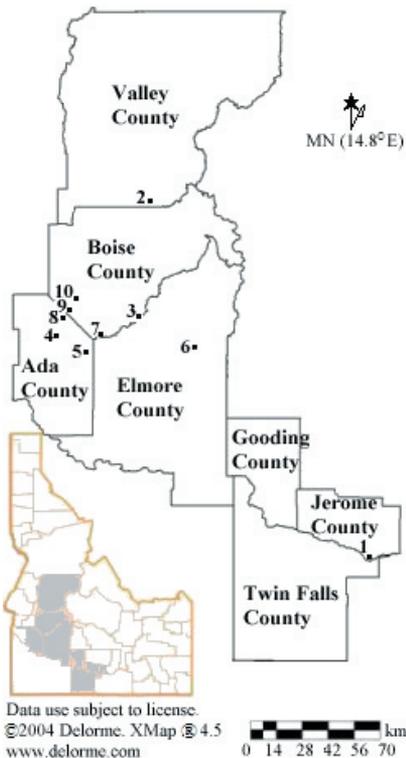


Figure 1: Survey Site Locations for Wormlions (*Vermileonidae*) in Idaho

Location No.	Date	Site	County	Latitude	Longitude
1	Jul-95	Snake River	Jerome	N 42.4960°	W 114.1310°
2	Aug-95	Deadwood Reservoir	Valley	N 44.3030°	W 115.6390°
3	Aug-95	Sheep Creek	Boise	N 43.6950°	W 115.6610°
4	Jul-95	Boise	Ada	N 43.6000°	W 116.2167°
5	Aug-95	Lucky Peak Reservoir	Ada	N 43.5234°	W 116.0682°
6	Jun-05	Elks Flat Camp Ground	Elmore	N 43.5419°	W 115.2975°
7	Jun-96	Macks Creeks	Ada	N 43.6114°	W 115.9319°
8	Jul-00, Jul-03, Jun-04	Dry Creek	Ada	N 43.6881°	W 116.1862°
9	Jul-03	Bogus Basin Road	Boise	N 43.7305°	W 116.1389°
10	Jul-03, Jun-04	Shafer Butte	Boise	N 43.7907°	W 116.0942°

*Table 1: Latitude/Longitudes for Survey Site Locations*

## **AUTOMATED IMAGING WITH A HAND-HELD METAL DETECTOR— THE SCANNING RADIO IMAGER**

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We developed a technique for making pictures using an ordinary hand-held metal detector—we changed a hand-held metal detector into a camera. This was done by raster-scanning the metal detector head under computer control with stepper motors. The resulting imager, called a Scanning Radio Imager (SRI), was used to image various metal objects including coins and hidden weapons, such as a knife and firearms. Complicated targets were distinguished and their shapes and relative orientations determined. Images illustrating this will be presented as well as details of operation. This technique holds great potential for such diverse applications as land-mine detection, gold prospecting, and security operations.

### **I. INTRODUCTION**

The portable metal detector has been a very important tool for both the professional and the hobbyist alike since its invention<sup>1</sup> in 1925 by Gerhard Fisher. It has been used in a multitude of diverse applications from land-mine detection to gold-nugget prospecting. The standard method of operation for the hand-held metal detector has been for an individual to grasp the metal detector in hand and “wave” it over a target region while listening for the audible tone produced when it passes over a metal target. Although this technique is useful, it is quite primitive. It would be much more valuable if the metal detector could make an actual picture of the target area showing in picture form the shape and size of the target. In this paper we will show how this can be done. In effect we will show how to turn an ordinary hand-held metal detector into a camera. To illustrate the kind of pictures that can be obtained with this technique Fig. 1a is presented which shows an image which looks like a man’s face somewhat reminiscent of the shroud of Turin. The eyes, hair, and mouth of the image, however, were formed from dimes, copper wire, and electrical solder arranged as shown in Fig. 1b. The metal detector image clearly shows the relative orientation and placement of these items, and such detail would be impossible to obtain using the conventional “waving” method of operation of the metal detector. This illustrates, how advantageous it would be to be able to “take pictures” with a metal detector. In the next section of this paper we will describe the principles of operation for making such images. This will be followed by a description of the instrument, some example pictures, and finally our conclusions.

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<sup>1</sup> Alexander Graham Bell invented a crude non-portable metal detector in 1881 and used it in an attempt to find an assassin’s bullet in President James Garfield, but he was largely unsuccessful in this attempt.

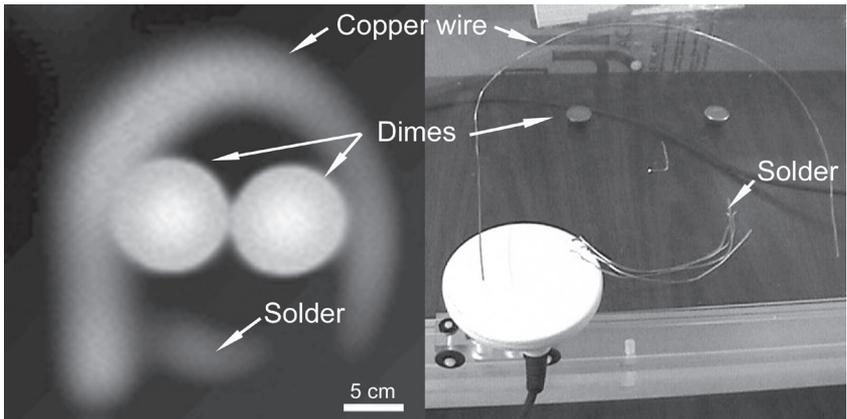
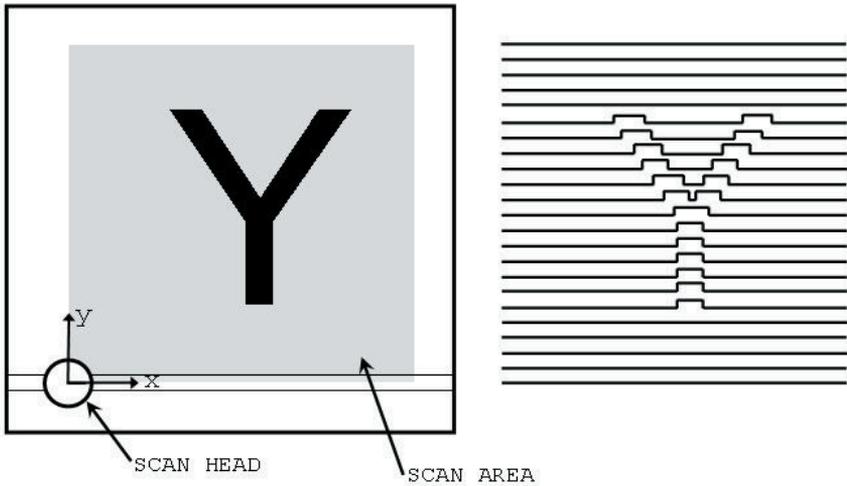


Figure 1. Metal detector image of a “face” made from wire and coins. The SRI image on the left (Fig 1a) looks like a face resembling the Shroud of Turin. This image was made by scanning the coins and wire pictured on the right (Fig. 1b) with the circular white metal detector head shown at the lower-left of this picture. The eyes, hair, and lips in the image were produced from dimes, solid copper wire, and hollow solder strands, respectively. The distance between the top of the metal detector head and bottom of the metal was about 1 ½ cm.

## II. PRINCIPLES OF OPERATION

The conventional means of operation of a hand-held metal detector is to “wave” the detector over potential targets in a more or less random fashion while listening for an audible beep. This is the method frequently used by treasure hunters, prospectors, and even land-mine sweepers.<sup>2</sup> Although the location of a metallic object can be determined in this fashion, its shape, size, and orientation cannot easily be ascertained without digging it up. If on the other hand, an image of the target could be made without having to dig it up, this could prove very useful when trying to discriminate between junk and desirable targets. Such images can be made when the “random waving” motion of the metal detector is replaced with uniform scanning motion controlled by a computer, for then the resulting metal detector signal can easily be plotted as a function of position and an image produced. This procedure is schematically illustrated in fig. 2a where a rectangular target area (labeled “scan area”) is shown on the left of the figure. The first step is to raster scan this area with the metal detector head, first scanning in the x-direction (horizontally) and then in the y-direction (vertically) while simultaneously recording the metal detector signal. After a line is scanned, it can be plotted as shown schematically in Fig 2b where a number of such line scans are shown. The vertical displacement along a given line corresponds to the intensity of the metal detector signal, and the overall vertical position of a

<sup>2</sup> National Geographic, May 2002, “The Land Mine Wars,” v. 201, no. 5.

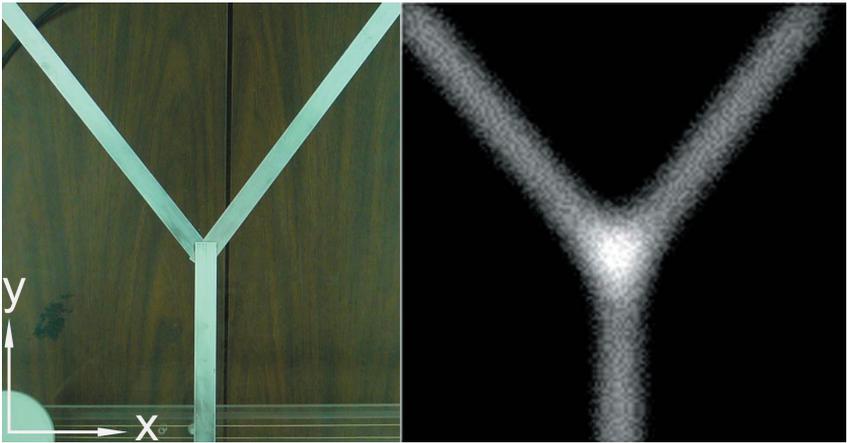


*Figure 2. SRI Principles of Operation. A schematic representation of the scanner, scan area or target area, and target are shown on the left (Fig. 2a), and a line-scan image of the scan area is displayed on the right (Fig 2b). The “Y” on the left, made of metal, is the target and is scanned by the scan head which is first moved in the x-direction while recording the metal detector signal as a function of position. This signal is then plotted as the bottom line in the right figure. The head is then moved back to the origin and up one unit in the y-direction and the process repeated to produce the next scan (second line from the bottom). This procedure is continued until the entire “Y” is scanned and the complete line-scan image produced. Since regions where the scan head is near the “Y” produce more signal with a corresponding “blip” on a line, an image of the “Y” results when the line scans are plotted vertically displaced from each other as shown on the right. These line scans can then be converted into a gray-scale image if desired.*

given line represents the y-position of the metal detector head in the target area. For example, the first line scan of our schematic image was made by moving the metal detector head, (the head) from the origin (lower-left of the target area) to the right, while simultaneously recording the metal detector signal, until the maximum x-value was reached at the right side of the target area. The resulting line was then plotted (a plot of metal detector signal versus x-position) with any appreciable metal detector signal appearing as a blip on the line (the first blip occurs at line six corresponding to the bottom of the “Y”). The head was then repositioned to the left side of the target area and the y-position incremented by one unit (moved up by one unit) and the process repeated to obtain the second scan line. This process was then repeated until the entire target area was systematically scanned and then a pseudo-three-dimensional picture was made by displacing adjacent line scans vertically and plotting them as shown in Fig. 2b. The resulting picture clearly shows the “Y” of the target area. Furthermore, because each point or pixel in the scanned area has a metal detector signal associated with it, it is easy to make a gray-scale image of the target area. In such an image regions of high metal detector signal are colored white and regions of

low signal are colored black with intermediate regions colored gray. An example of such a gray-scale image (but for actual data) is shown in Fig. 3b for the metal “Y” depicted in Fig. 3a. The white areas correspond to regions where there was metal, and the dark regions correspond to areas where there was none. Variations in brightness correspond to differing amounts of metal and will be discussed later. This image is composed of 22,500 pixels, corresponding to 150 points/line in the x-direction and 150 line scans in the y-direction.

This process of making a picture by scanning a probe is not new. It is used in numerous experimental techniques such as in Scanning Tunneling Microscopy (STM),<sup>3</sup> Scanning Electron Microscopy (SEM), and in Ground Penetrating Radar.<sup>4</sup> Our work with STM<sup>5</sup> gave us the idea of scanning a hand-held metal detector in an automated fashion for the purpose of making images of possible placer



*Figure 3. Comparison of SRI image of a metal Y to a photograph of the actual “Y.” On the left (Fig. 3a) is shown a photograph of a metal “Y” made from three strips of 2.0 cm wide Aluminum. On the right (Fig 3b) is the corresponding SRI image which looks strikingly like the actual metal “Y.” The image, in addition, shows more of a metal signal at the intersection point of the “Y” as is evidenced by the brighter area at this point. This results because the three metal strips intersect and overlap there, as can be seen in the photograph on the left. It is interesting to note that the SRI clearly indicates an increased signal at this overlap point. (The scan area for the image was 40 cm x 40 cm with 150 line scans of 150 points each. The average scan rate was 4.2 cm/s. The metal strips were 6 cm above the top of the scan head and were cut from 1/32 inch thick stock (0.079 cm).)*

<sup>3</sup> G. Binnig, H. Rohrer, Ch. Gerber, and E. Weibel, Phys. Rev. Lett. 49, 57(1982).

<sup>4</sup> R. Birken, D. E. Miller, M. Burns, P. Albats, R. Casadonte, R. Deming, T. Derubeis, T. Hansen, and M. Oristaglio. “Efficient Large-Scale Underground Utility Mapping in New York City Using A Multi-Channel Ground-Penetrating Imaging Radar System.” Proceedings of the Ninth International Conference on Ground Penetrating Radar, April 29-May 2, 2002, Santa Barbara, California.

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Au deposits. We, therefore, named this technique Scanning Radio Imagery<sup>6</sup> or SRI for short, and when referring to the instrument itself we call it a Scanning Radio Imager also denoted SRI. We made our first preliminary image in 2000, and our first high-resolution images in 2001. Since then a number of interesting examples of imaging with a single metal detector head have appeared in the literature. Chesney and Das built a Remotely Operated Vehicle with a metal detector mounted on it for land-mine detection.<sup>7</sup> Zanzi, et. al.<sup>8</sup> built a large scale scanning platform (target area 6 m x 80 m) for scanning either a Ground Penetration Radar head or a conventional metal detector head in an effort to detect land-mines. Furthermore, Gaydecki<sup>9</sup> has done some very noteworthy work, dating back into the 90s, using an array of small inductive scanners to image steel bars in concrete. Our work differs from his, in part, in that we present a low-budget method for taking an ordinary hobbyist metal detector and transforming it in a simple manner into an imaging device. Moreover, our images are, to the best of our knowledge, some of the highest-resolution images presently published.

### III. APARATUS

The instrument we built looks like an oversized x-y plotter with a scan area of almost 1 meter by 1 meter, and it uses stepper motors, strings, and pulleys to scan the head in two orthogonal directions under computer control. Fig. 4 shows a picture of the instrument which was made entirely with nonmetallic materials (Plexiglas, nylon screws, plastic pulleys, string "cabling" and Viton O-rings). The stepper motors, however, were metallic and so were placed at one end of the instrument as far as practically possible away from the scan area. The head motion was controlled by strings, which were routed with pulleys, and attached to the head and the stepper motors. Strings were chosen to control the head motion because they offered a simple means for mounting both motors at the same end of the scanner as far as practically possible from the scan area. The head was attached to a wheeled cart which rolled along a Plexiglas track as it was pulled along by the "x-string." A picture of the head on the cart and track is shown in Fig. 5. The track over which the cart moved is labeled the "x-track"

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<sup>6</sup> W. Tennyson, J. Chapman, and W. E. Packard, "The Scanning Radio Imager—how to make a camera out of a metal detector," Tenth Regional Conference on Undergraduate Research, Murdock College Science Research Program, Spokane, WA November 2001.

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<sup>8</sup> Zanai, L., Lualdi, M., Braun, H. M, Borisch, W., and Tritzschn, G. "An Ultra High Frequency Radar Sensor For Humanitarian Demining Tested on Different Scenarios in 3D Imaging Mode." Proceedings of the Ninth International Conference on Ground Penetrating Radar, April 29-May 2, 2002, Santa Barbara, California.

<sup>9</sup> See [www.dias.umist.ac.uk/PAG/inductive.htm](http://www.dias.umist.ac.uk/PAG/inductive.htm) and references therein.

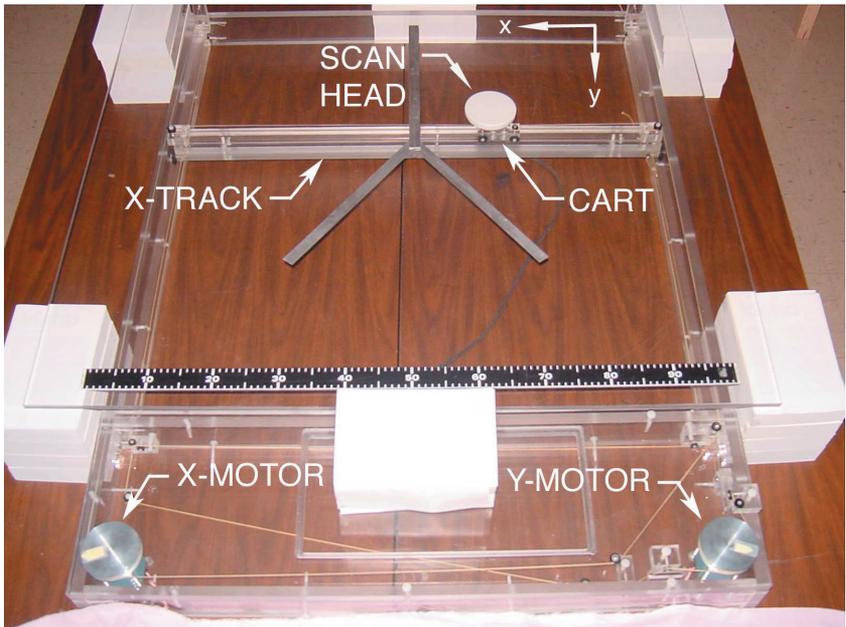
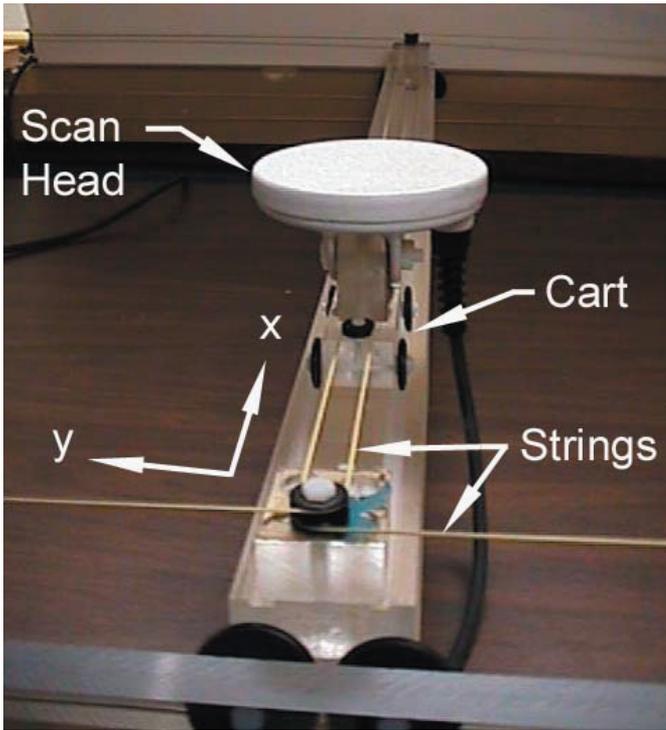


Figure 4. Photograph of the SRI apparatus. The metal “Y” of Fig. 3a rests on top of a Plexiglas plate which sits above the scan head (scan coil). The scan head moves in the x-direction along the x-track and the whole x-track moves in the y-direction. These motions are controlled by the x-motor and the y-motor through the use of strings and pulleys. The scan area is nominally 1 m x 1 m and a black meter stick is shown lying on the Plexiglas plate for comparison. This plate is supported by a number of white rectangular posts (stacked books). The whole unit sits on two wooden tabletops. The entire scanning apparatus is made from non-metallic material (Plexiglas, nylon screws, plastic, and Viton) except for the motors and the wires of the scan head.

because the cart moved in the x-direction when it traveled along this track. Likewise, the string which controls this motion is called the “x-string” and it connects to the “x-stepper motor.” As shown in the figure the head pointed upward toward the ceiling and objects to be imaged were placed above the head on a Plexiglas support surface as is shown in Figs. 1b, 3a, and 4. (The head faced upward for ease of use allowing easy target placement and target height adjustment. For field use the head would be repositioned to face downward toward the ground.) Moreover, the whole “x-track” was moveable in the y-direction and this motion was controlled by another string, the “y-string” which connected to the other stepper motor, the “y-motor.”

The stepper motors were controlled by a computer (through appropriate electronic drivers<sup>10</sup>), and the computer was controlled by a C++ program which

<sup>10</sup> The stepper motors (Superior Electric KML062F07) were each driven by a driver (Warner Electric SLO-SYN Model SS2000MD4-M) which received pulses directly from the digital output of the Digital-Digital converter on the computer.



*Figure 5. Close-up view of the scan head and cart. The scan head sits on a Plexiglas cart which has plastic and Viton wheels. These wheels sit on the x-track and the cart's motion along this track in the x-direction is controlled by the strings shown. The Plexiglas plate where targets sit was removed for clarity.*

we wrote. The program controlled the scan rate,<sup>11</sup> scan size, scan direction, data acquisition, and imaging. The metal detector we used was a Fisher Gold Bug<sup>12</sup> with the detector head<sup>13</sup> mounted on the cart as already shown in Fig. 5. The audio output of the metal detector electronics module was used to obtain a signal readable by the computer. This was done by modifying the output signal with a passive integrator. The unmodified audio signal when connected to an earphone headset produced a loud high-frequency tone whenever metal was brought near the head with the sound increasing in both volume and pitch as

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<sup>11</sup> Typical scan rates were 6 cm/sec with typical scan times of 16 minutes for a 10,000 pixel picture (100 points/line and 100 lines/picture). The upper limit of the scan speed for our system was limited by our stepper motor controllers. Furthermore, we only took data on the "down" scan and not on the "back" scan to avoid backlash effects. If we had taken data in both directions, the scan time could have been cut nearly in half.

<sup>12</sup> Serial Number 17714.

<sup>13</sup> The metal detector scan head was a Fisher 3-3/4 inch diameter circular search coil (m-scope) made for the Gold Bug.

the distance between the head and the metal became smaller. This sound was produced because the Gold Bug output was a series of narrow square pulses whose height and frequency of occurrence increased with increased proximity of the head to metal. Instead of passing this signal through a headset we passed it through a passive integrator, made from a resistor and capacitor,<sup>14</sup> which produce a DC signal whose amplitude was approximately proportional to the area of the pulses and correlated with both the volume and the increased frequency originally heard in the headset. This DC signal could then easily be read by an Analog to Digital Converter (ADC) and was a measure of the “amount” of metal present.<sup>15</sup> This method of manipulating the detector signal so the ADC could read it, although not optimal, was chosen because of its simplicity and ease of implementation.

To form an image the computer raster scanned the head across the target area while simultaneously measuring the signal from the metal detector electronics module. For example, to make an image the computer positioned the scanning head at a given point in the scan area, then the audio output signal from the metal detector electronics module was sent through the low-pass filter with the resulting DC signal being sent to the computer's ADC.<sup>16</sup> This digital signal was then stored in the computer's memory along with the head's positional information, and was used to plot another pixel in the gray-scale image of the target area. The head was then moved to the next position and the process continued until the complete target area was scanned and an image made on the computer monitor.

Since the SRI uses a scanning technique to form an image, image acquisition is not instantaneous. Our image time for our prototype SRI is presently on the order of 10 minutes, depending on scan size and desired resolution. For many applications this is not an undue limitation since the process is completely automated; however, for other applications it could be severe. Through thoughtful design, scan times of one minute or less per square meter should be attainable (also see footnote 11).

#### IV. RESULTS & DISCUSSION

The SRI is a valuable tool for imaging complicated and varied objects. We imaged a number of objects: wires, pieces of metal, coins, and hidden weapons. We will discuss each of these in turn. First as was mentioned in the introduction we demonstrated that the SRI can detect arrangements of wire which outline a face, as was shown in Fig. 1 where various metallic materials--copper wire, dimes, and solder strands--were arranged to produce a smiling face. The dimes

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<sup>14</sup> The Gold Bug's output signal was fed to a 5 K resistor which connected to the ADC input. This input was then shunted to ground by a 1 microfarad capacitor in parallel with a 47 K resistor. This circuit functioned as a “poor-man's” integrator.

<sup>15</sup> The Gold Bug's search coil, the head, is really two coils. The transmitter coil sends out a radio wave at 19.2 KHZ and the other coil, the pick-up coil, picks up any wave reflected by a target into the coil. The wave from the transmitter coil induces currents in conductive targets, and these produce a time varying magnetic field which is detected in the pick-up coil. The Gold Bug's output is related to both the intensity of the signal received by the pick-up coil, and by the phase of this signal relative to the transmitted signal. More output signal at the headphone jack results from a more intense signal, or from a phase shift. The details of how the electronics does this are held as a trade secret by Fisher.

<sup>16</sup> A 12-bit ADC was used.

represented the eyes; the solder, the lips and nose; and the copper wire, the hair and outline of the head. These items were placed about 1-1/2 cm above the white circular scanning head on a Plexiglas sheet. The image clearly shows the general features of the "face," and the relative orientation of the objects, illustrating the sensitivity SRI has to the spatial orientation of targets *i.e.* it would have been impossible to determine that these objects were arranged to form a face by using the conventional "waving" method of metal detector operation.

In addition there is variation in brightness between different metal objects in the image as one would expect. The dimes, for example, are much brighter than the solder strands since they contain more metal in a concentrated arrangement and have a larger lateral area than the strands. Moreover, the solid Cu wire appears brighter than these hollow solder strands even though both have approximately the same diameter. This illustrates that the SRI technique can differentiate between objects of nominally the same size and shape. The apparent size of the objects in the image, however, is increased due to instrumental broadening. The dimes, for example, appear to be a little more than 9 cm in diameter up from their actual diameter of 1.8 cm. This is a result of the scanning head being a lot larger than that of the dimes (scanning head diameter is 9.6 cm). Instrumental broadening will be discussed further below.

We arranged three strips of metal to form a "Y"<sup>17</sup> and were able to image it as shown in Fig. 3 and already mentioned. The image clearly reproduces the shape of the "Y" with amazing detail, and it shows that the instrument is sensitive not only to different kinds of metal as suggested in Fig. 1 (and later Fig. 7), but also to the amount of a given kind of metal present. At the intersection of the "arms" of the "Y" the image shows a brighter area which is the result of an increased metal detector signal there due to the convergence and overlap of three metal strips. This is reasonable since the thickness of each of the strips is comparable to the skin depth for the metal detector's radio wave, and so the wave penetrates through more than one strip.<sup>18</sup> This illustrates that the SRI technique can differentiate between regions of higher and lower metal concentrations produced merely from the overlap of pieces of metal. Such subtle differences (between the arms of the "Y" and the intersection point of the "Y") could never be observed with the conventional "waving" method of metal detector use.

In this image, because of instrumental broadening, the arms of the "Y" appear about 50 % wider than their actual size (2.8 cm compared to an actual size of 2.0 cm). Caution must be exercised, though, in attributing sizes to target features based on the apparent size of a feature in an image, because the apparent size depends on a number factors including the diameter of the metal detector head,

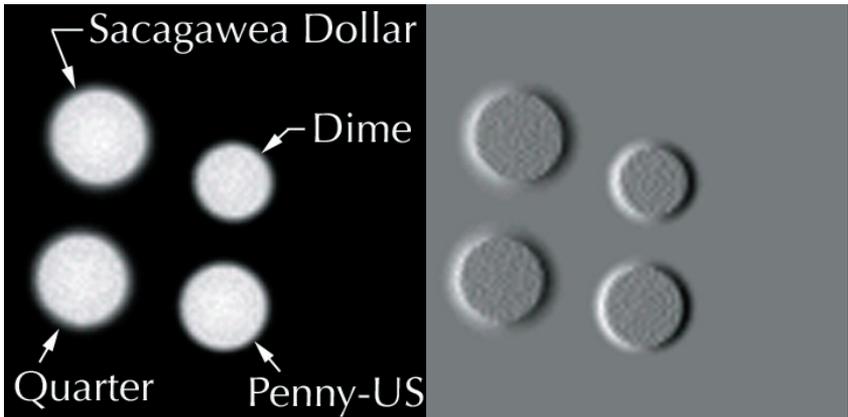
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<sup>17</sup> The "Y" was made from three 2.0 cm wide strips of sheet metal placed on top of a half-inch thick (1.27 cm) sheet of Plexiglas and placed 6 cm above the metal detector head. The sheet metal thickness was 0.079 cm (1/32 inch).

<sup>18</sup> The sheet metal strips are primarily Al although the alloy composition is unknown. For Al the skin depth at 19.2 KHZ (the operating frequency of the Gold Bug) is 600 micro-meters and the thickness of the strips is comparable at 790 micro-meters.

the controls on the metal detector<sup>19</sup>, and the details of the gray-scaling.<sup>20</sup> For Fig. 3b these variables were set to minimize the apparent width of the arms of the “Y.” If more resolution in an image is necessary, a smaller diameter head could be used to increase resolution but this would decrease depth sensitivity and so a trade off must be made. Nonetheless, even with instrumental broadening, the basic shape of numerous objects is determinable with SRI.

One of the popular uses for a metal detector is for finding coins. In conventional use the user “waves” the detector over the ground and when a beep is heard the target is dug up with anticipation and with the hope of finding an old coin like a Silver Dollar or perhaps even a Spanish Piece of Eight, but instead the user usually finds just a bottle cap, or a piece of aluminum foil, or a similar piece of junk. For this situation the SRI can provide aid for it can make an image of the coins and can even differentiate between differing coin denominations as illustrated in Fig. 6 where two different renderings (gray-scale and derivative<sup>21</sup>) of



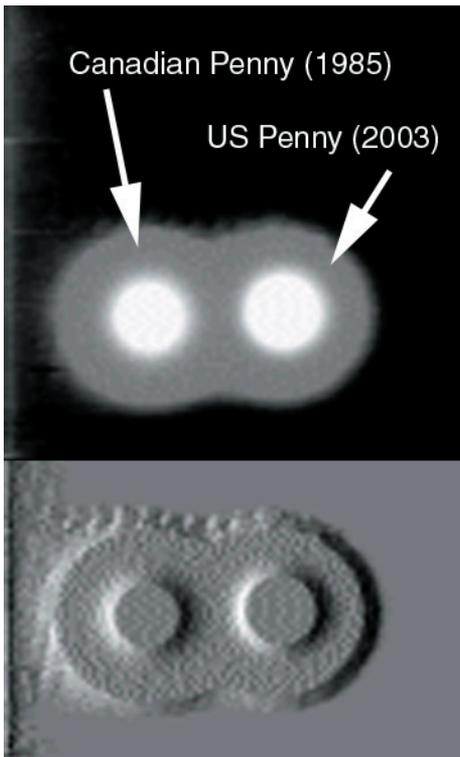
*Figure 6. Four coins of differing size can easily be distinguished and ordered according to size. The image on the left is a gray-scale SRI image of a Sacagawea dollar, a quarter, US-penny, and a dime all at the same height. The image on the right is a derivative image of the same coins. (For a derivative image the slope of each point on a line scan is determined and this slope is gray-scaled. See footnote 21 for more details.) In these images, the dollar appears larger than the quarter, the quarter larger than the penny, and the penny larger than the dime. This is the same ordering that would result if the coins were arranged according to their physical size. (scan size 40.6 cm x 40.6 cm, image size 100 x 100 points, scan time 16 min, distance between bottom of coins and scan head, 2 cm)*

<sup>19</sup> There are controls on our metal detector electronics for sensitivity, ground reject, and volume.

<sup>20</sup> What signal intensity is used for all white and what intensity is used for all black i.e. what signal determines the top and bottom of the gray-scaling range, also affects the apparent target size.

<sup>21</sup> In the gray-scale mode signal intensity is gray-scaled, i.e. more intense signals are represented as brighter areas. In derivative mode the image appears as if it were illuminated from the left because the slopes of the line scans are gray-scaled i.e. positive slopes of a line scan are displayed as bright areas and negative slopes as dark areas.

an arrangement of four different coins is displayed. These coins were all on the same level, 2 cm above the metal detector head, resting on the Plexiglas plate. These coins are a Sacagawea dollar, a quarter, a dime, and a US penny. In the image the Sacagawea dollar looks bigger than the quarter, and the quarter bigger than the penny, and the penny bigger than the dime. This ordering, in fact, is correlated to their actual size and is the same as one would have if the coins were arranged according to their diameters. Therefore, SRI can even be used to differentiate between different coin sizes. Caution must be exercised when doing this, however, because image size not only depends on target size, but also on target composition. This is nicely illustrated in Fig. 7 where the image of a US penny and a Canadian penny is shown. The Canadian penny's image (coin on the left) appears slightly smaller than the US penny's image even though both pennies have essentially the same diameter and weight.<sup>22</sup> This is a real effect



*Figure 7. A Canadian penny appears smaller than a US penny even though both pennies have the same diameter and weight. The SRI image of a US penny and Canadian penny is shown in gray-scale mode (top) and derivative-mode (bottom). Both views show that the Canadian penny's diameter in the image is smaller than the US penny's even though both pennies have essentially the same physical diameter and weight [see footnote 22] and were at the same height. This size difference in the SRI image is due to a composition difference. The US penny is mostly zinc with a little copper while the Canadian penny is mostly copper with a little zinc. (scan size 40.6 cm x 40.6 cm, image size 100 x 100 points, scan time 16 min, distance between bottom of coins and scan head, 2 cm)*

<sup>22</sup>The pennies have essentially the same weight and diameter. We measured 2.49 gm for the US penny, and 2.55 gm for the Canadian penny, but both pennies have a specified weight of 2.5 gm. For the diameters we measured 19.07 mm for the US penny, and 19.07 mm for the Canadian penny at its greatest point (the Canadian penny is not round but 12-sided). This agrees with the specified diameter of the US penny of 19.05mm and the specified diameter of the Canadian penny of 19.1 mm. The Canadian penny has a 12-sided perimeter whereas the US penny has a circular perimeter and when they are stacked on top of each other no significant difference in diameter can be detected between the pennies by the hand; however, the flat sides of the Canadian penny can be felt and distinguished from the rounded side of the US penny.

and not an artifact because when we swapped the positions of the pennies the smaller coin in the image also swapped positions and followed the Canadian penny. At first thought this seems amazing since both pennies have an outer surface of Cu. The difference in signal, however, is attributable to the difference in the internal compositions of the pennies. The US penny (2003 D) is copper coated zinc (97.5% zinc, 2.5 % copper<sup>23</sup>) and so is mostly zinc whereas the Canadian penny (1985 KG) is mostly copper (98.0% copper, 1.5% zinc, 0.5% tin). The metal detector, therefore, “looks into” the pennies and “samples” their interiors. This is reasonable since the skin depth for Cu at the frequency used by the Gold Bug (19.2 KHZ) is 470 micro-meters—almost half a millimeter—which is comparable to the thickness of the pennies. The Cu exterior of the US penny, therefore, contributes minimally to the signal<sup>24</sup> (for comparison Zn has a skin depth of 880 micro-meters).<sup>25</sup> This figure, therefore, illustrates that the SRI can differentiate between coins of the same size but with different compositions.

Finally, in these days of tightened security another tool for finding hidden weapons could prove useful, especially at airports. SRI has the potential for finding hidden weapons as is illustrated in Fig. 8. We hid a knife in a book by cutting out a space for the knife in the book’s center and placing the knife in the void as shown in Fig. 8c. The book was then closed (Fig. 8a) and imaged with the SRI. The knife, though invisible to the eye, was clearly visible in the SRI image which is shown in Fig. 8b. The SRI “looked” through the closed book to see the knife. The shape of the open knife is clearly visible although fine details are washed out because of instrumental broadening due to the relatively large metal detector head size. Nonetheless, the image illustrates the great potential of SRI for detecting weapons. We have also successfully used the SRI to image a pistol (Ruger Mark II .22 caliber) concealed in a cardboard mailing box, and to image a second pistol (H & K .45 Auto) held in it’s plastic carrying case. One might wonder what advantage SRI would have over conventional more precise X-ray imaging systems which are in use at airports today or under development.<sup>26</sup> First, SRI is considerably less expensive than X-ray instruments because it is inherently simpler on the instrumental level. Secondly, SRI presents no health risk, unlike X-rays, and thirdly, SRI could be a supplemental tool to augment the X-ray systems already in use and could replace the “by-hand wandng” currently used at airports.<sup>27</sup> SRI could have innumerable other security applications as well.

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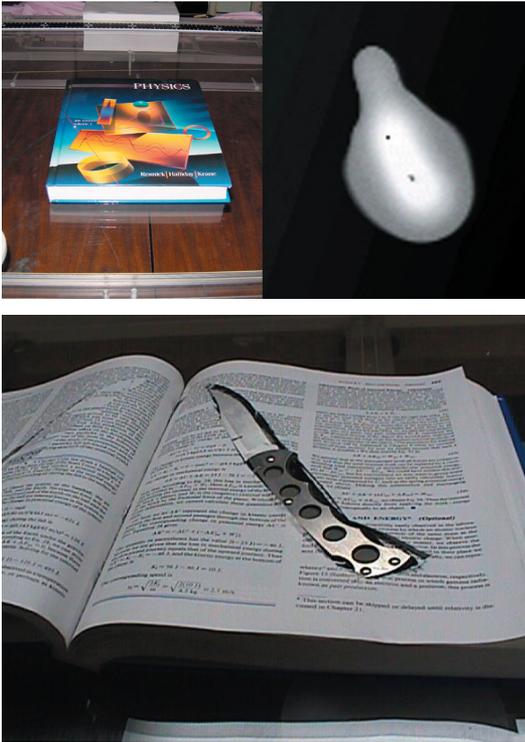
<sup>23</sup> This is the total content. The coating is pure copper over a core of 99.2 % zinc and 0.8% copper.

<sup>24</sup> We chemically removed the Cu from the surface of a US penny, exposing the zinc, and found that it still “looked bigger” in the SRI image than the Canadian penny.

<sup>25</sup> One might wonder why the Zn penny (US) appears larger than the Cu penny (Canadian) since pure copper has 3.6 times the electrical conductivity of Zn, and so should contribute a stronger signal than Zn. The Zinc appears larger, almost certainly, because it produces a different phase change due to its nearly double skin depth compared with Cu. The details of the Gold Bug’s detection electronics are proprietary according to Fisher (for Fig. 7 a midrange Ground Reject setting of five was used). The important point here is that a difference in composition produces a different image size.

<sup>26</sup> National Geographic, November 2003, “Watching you,” v. 204, no. 5, page 2, (see page 22).

<sup>27</sup> Of course, the orientation of the SRI instrument would have to be changed to suit the application. For example, to scan an airline passenger the scan plane would need to be made perpendicular to the floor rather than parallel to it as it is in Fig. 4, and for this application the SRI instrument would have to be engineered to scan more quickly, but this is feasible.



*Figure 8. Hidden weapons can be found with the SRI. The book shown in Fig. 8a was scanned and the image of Fig. 8b obtained. This image indicates that an oblong piece of metal was in the book. When the book was opened the hidden knife of Fig. 8c was found. The SRI image shows the general shape of the knife although the details were obscured because of the larger diameter of the scan head. This illustrates that SRI can be used to detect hidden weapons. (scan size 35 cm x 35 cm, image size 100 x 100 points, book bottom 1 cm above scan head)*

Finally one might ask, “What determines the size and/or brightness of an object in an SRI picture?” In addition to the control settings of the metal detector and the details of the gray-scaling, which were discussed above, apparent size is also determined by four basic factors which are: Scan head size, target size, target material, and target configuration. The image resolution is limited by the scan head diameter. A large diameter head would make even a pin-point object appear large. A small head, on the other hand, would provide more resolution, but at the expense of depth sensitivity. Secondly, targets of greater lateral extent appear wider in SRI images. If a gold coin were flattened to increase its diameter by a factor of 10, then its SRI image would also increase commensurately, but not exactly by 10, because the original coin would appear larger than actual size due to finite scan head size. To a lesser extent increased target thickness can also increase image size and/or brightness as we saw in Fig. 3. Thirdly, some target materials, though the same size, appear bigger or brighter in images due to composition differences as we saw in Fig 7. In general, highly conductive materials give more signal than poorly conductive ones and so appear larger or brighter. For example, coins produced SRI images, but the Plexiglas shelf they sat on did not. It was invisible. One must be careful, though, for there are cases where a less conductive material appears bigger in an image than a more conductive one as we already discussed (see footnote 25). Finally, target configuration

affects image size and/or brightness. We found, for example, that a small loop of electrical solder appears very large in an SRI picture compared with the same amount of solder not arranged in a loop. This is understandable because the loop produces a larger magnetic field at the sensing coil. Therefore, the target configuration can also have a substantial affect on image size. The effect of these four factors on image size/brightness is still being investigated.

## V. CONCLUSIONS

In this paper we introduced a new technique, Scanning Radio Imagery (SRI), which transforms an ordinary metal detector into a camera allowing pictures to be made of hidden metallic objects. Such pictures are made by raster scanning the metal detector head over a target area and plotting the resultant metal detector signal as a function of the head position. The resultant image, or picture, can show the shape and relative orientation of the metal contained in the scanned area and can elucidate far more detail than is obtainable from conventional metal detection means of operation. Even a complicated arrangement of metallic objects can easily be observed and the objects distinguished. This was demonstrated in Fig. 1 which shows the image of a face made from strands of Cu and solder arranged in the shape of a visage. We also showed that SRI images can detect different *amounts* of metal for objects of the same composition and shape (Fig. 3), as well as differentiate between different *kinds* of metal for objects of the same shape (Fig. 7). Moreover, we demonstrated that coin denominations ranging from a Sacagawea dollar to a penny could easily be distinguished by SRI (Fig. 6). Finally, we showed that this instrument could be used to find hidden weapons such as a knife concealed in a closed book (Fig. 8).

This ability to make a picture with a conventional metal detector has great potential, for it is much easier to look at a picture of a target and make judgements as to its shape than it is to make such judgements based solely on an audible beep. It offers a better means of target identification and discrimination, and therefore, it could have great implications for many important problems including land-mine detection, weapons detection, and utilities detection, and it could also be valuable for prospectors and treasure hunters alike. Much more work is needed to fully develop this technique, but when it is fully developed, it will prove extremely valuable.

## ACKNOWLEDGEMENTS

We would like to thank Francis Sharpton for his valuable assistance and the R. J. Murdock Charitable Trust for their support for Undergraduate Research.

## FIRST RECORD OF MARINE BLUE (LEPIDOPTERA: LYCAENIDAE) IN IDAHO

Miriam L. Austin<sup>1</sup> and Kent Fothergill<sup>2</sup>

**Keywords:** *Leptotes marina*, Marine Blue, Idaho, Sawtooth National Forest, Lepidoptera, Range Extension

According to Pyle (2002) *Leptotes marina* (Reakirt) (Marine Blue) is one of several essentially subtropical species of blues (Lepidoptera: Lampidini) that regularly expand their summer ranges only to die back in the fall. Opler et al. (1995) compiled a web-based atlas of verified butterfly occurrences for Canada, the United States, and Mexico; this atlas reports no *L. marina* occurrences in Idaho. Pyle (2002) cites two occurrences of *L. marina* in central Oregon. Glassberg (2001) describes *L. marina* as emigrating northward and eastward from southern population centers, rarely reaching Oregon and Saskatchewan. Brock and Kaufman (2003) include a range map for *L. marina* that indicates, the possibility of this species straying into southern Idaho.

On August 7<sup>th</sup>, 2005, at 1750 hours, the authors found and photographically documented *L. marina* at 12T 0332363 UTM 4703502, elevation 5557 feet, in North Heglar Canyon of the Sublett Mountains within the Sawtooth National Forest in Cassia County, Idaho. This area had riparian associated shrubs and taller conifers nearby, but the flush of weedy growth associated with road-related disturbance was the habitat utilized by *L. marina*. This individual was strongly associated with a small clump of *Medicago sativa* L. (alfalfa), which it nectared on and never left during the 25 minutes the authors observed it. Other species of butterflies (Lepidoptera: Rhopalocera) in the immediate area included:

<i>Pontia protodice</i> Boisduval and Leconte	Checkered White
<i>Colias eurytheme</i> Boisduval	Orange Sulphur
<i>Satyrrium saepium</i> Boisduval	Hedgerow Hairstreak
<i>Lycaeides melissa</i> W.H. Edwards	Melissa Blue
<i>Icaricia acmon</i> Westwood and Hewitson	Acmon Blue
<i>Phyciodes mylitta</i> W.H. Edwards	Mylitta Crescent
<i>Hesperia comma</i> L.	Common Branded Skipper
<i>Ochlodes sylvanoides</i> Boisduval	Woodland Skipper

No interaction was observed between *L. marina* and the other butterflies present.

Digital photographs (Figure 1) were sent to Mike Reese of the North American Butterfly Association and to Ray Stanford for confirmation of identification and that this documented occurrence is a first record for the State of Idaho. Digital photographs of this individual of *L. marina* are archived at the Orma J. Smith Museum of Natural History. The occurrence of *L. marina* brings the total butterfly taxa to 169 utilizing the taxonomy of Ferris (1989) and Miller and Brown

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*Fig. 1. Photograph of Leptotes marina, August 7, 2005, North Heglar Canyon, Cassia County, Idaho. Note the small size (compare to Medicago sativa flowers), distinctive striping on the underwings, and two bold marginal spots on hindwing.*

(1981) or 167 utilizing the taxonomy of the North American Butterfly Association (Cassie et al. 2001).

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## GREETINGS TO ALL

Hope that you are having a great year.

The next article in the Journal is not a typical “peer-reviewed” article, although it could have been reviewed. This article is both REAL science as well as tongue-in-cheek! It shows us all how science can be fun (something I forget that when I’m busy and a little stressed out with university and grant deadlines!).

I would like to recommend reading this article to see how our scientific process can be used with students to teach the method. I can imagine 5<sup>th</sup> graders through high school performing something similar to this technique to learn about the scientific method. I hope you enjoy this article as much as I did when it was shared with me. Enjoy!

Sincerely,

Chris L. Kapicka  
JIAS Senior Editor  
Northwest Nazarene University

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## VALUE ASSESSMENT OF BUTTER FLAVORED MICROWAVE POPCORN

by Alan Herbst, 1616 Christensen Drive, Blackfoot, Idaho

Popcorn has always been a popular snack food. Originally, it was prepared in a heated bowl with oil. This was messy and often took up to 10 minutes to heat and pop. Salt and butter were then added to the popcorn by hand mixing, which added to the mess. Next, came hot air poppers. These were faster, but left a completely bland tasting popcorn. The salt would not stick to the dry kernels; thus, it had to be drenched in butter to get a good flavor. Finally, the modern convenience of microwave popcorn hit the market. The oil, salt, flavoring, and, of course, the popcorn are contained in a paper bag, which is placed directly in the microwave oven. Within 3 to 5 minutes, a tasty bowl of popcorn is ready to eat. Several brands are now on the market, all making various claims about their product, such as, large kernels, great taste, minimum of unpopped kernels, even low fat, etc. Which is the "best" buy?

To answer that question, several brands of butter flavored microwave popcorn were purchased and subjected to a test in a home microwave oven. The "winning" popcorn should be the best tasting and provide the biggest kernels at a minimum cost. Also, the volume of popcorn should be the largest, while the unpopped kernels should be at a minimum. Low fat and calories will be considered for the diet minded. Taste is quite arbitrary, but my consumer taste buds sufficed for good butter taste and saltiness. The other attributes, volume, fat, and size, were quantitatively determined. The attached table lists the brands tested along with the cost per package and per ounce. The table also notes the nutritional information provided by the manufacturer, as well as the results of each test performed.

The average price is about 60 cents per individual package. ACT II popcorn is the least expensive on the market at 25 cents per package, whereas Newman's Own is the most expensive at a dollar a bag. The light popcorn runs a few cents more than the regular popcorn.

The total calories for a bag of popcorn ranges from 120 to 180. The light popcorn contains about the same amount of total calories, but the calories from fat are reduced by about half. Since salt is sodium chloride, the milligrams of sodium are an indication of the salt content. Albertson's Janet Lee Light has the least calories and is low in sodium. ACT II, Redenbacher's, and Smith's contain the most salt. Regular Pop Secret has the highest total calories at 180. ACT II, Newman's Own, and Redenbacher's follow closely with 170 calories. The carbohydrate, fiber, and protein contents are about the same, except for Healthy Choice, which has 27 grams of carbohydrates. All of the light brands are higher in carbohydrates than the regular ones. This may prove deceptive if you think you are eating a "diet" popcorn. Initially, there are less fat grams in the light brands; however, depending on your physical activity, the final fat grams may be higher. If you are active, carbohydrates are "burned" in the body, but if you are inactive, the carbohydrates are saved as body fat. Thus, light may not be light for you.

One package of each brand was sampled. Each bag was microwaved on high (650 watts) for 3 minutes and 35 seconds, so that time was not a factor.

The contents were then placed in a large measuring bowl and the volume noted. Several random kernels were measured and a general average size was recorded. The popcorn was removed and the volume of the unpopped kernels determined using a standard teaspoon. Lastly, the popcorn was personally tasted for butter and salt flavor. As stated, test results are found in the attached table.

ACT II produced the average 9 cups of popcorn and had a strong salt and butter taste. Pop Secret Light produced the least amount of popcorn (7½ cups) and had a very bland taste. The others ranged in between these two extremes. Redenbacher's popcorn lived up to its claim of large kernels and the greatest volume. It also had the least amount of unpopped kernels, which may account for the larger volume. Newman's Own, the most expensive brand, produced a small amount of popcorn, had a high volume of unpopped kernels, and had a bland to mild flavor.

In the battle of the grocery brands, Janet Lee surprisingly produced only 7½ cups of popcorn and had the smallest kernels. Janet Lee Light popcorn had an average volume and low unpopped kernels, but was bland tasting. Smith's produced the average 9 cups and had a good flavor. Smith's Lite produced a low 7½ cups of popcorn and had the largest amount of unpopped kernels at 7 teaspoons. Of the four grocery brands, only Smith's regular popcorn produced favorable results, but ACT II beats it on cost.

After stuffing myself with butter flavored microwave popcorn, here are my recommendations. If you like large gourmet kernels and are willing to pay for them, then Redenbacher's regular is your choice. If you are a light popcorn fan, Healthy Choice provides low calories and the most mild flavored popcorn at an average price. Finally, if you like salty, buttery movie popcorn at a fraction of the cost, then ACT II is the best choice because it provides the best flavor and the most "bang (pop) for the buck!"

Butter Flavored Microwave Popcorn	ACT II	Healthy Choice	Pop Secret	Pop Secret Light	Newman's Own	Redenbacher's	Redenbacher's Light	Janet Lee	Janet Lee Light	Smith's	Smith's Lite
Package Size (oz)	3.5	2.9	3.5	3.0	3.5	3.5	3.0	3.5	3.0	3.5	3.5
Price (\$/pkg)	0.25	0.56	0.70	0.70	1.00	0.66	0.58	0.46	0.46	0.33	0.33
Total Calories	170	130	180	140	170	170	120	150	120	160	130
Fat Calories	100	20	110	50	100	110	50	80	40	80	45
Fat (g)	11	3	13	6	11	13	6	9	4	9	5
Saturated Fat (g)	2.5	0	2.5	1.0	2.0	2.5	1.0	1.0	0.5	1.5	1.0
Sodium (mg)	400	340	300	250	180	390	360	340	260	400	380
Carbohydrates (g)	19	27	17	22	16	15	20	15	18	17	20
Fiber (g)	4	4	3	3	3	4	5	4	4	4	5
Protein (g)	3	4	2	4	2	2	3	2	3	3	3
Popped Volume (cup)	9	9	8½	7½	8	9½	9½	7½	8½	9	7½
Unpopped Volume (t)	3	4	2½	4½	4	1	2	3½	1½	4	7
Kernel Size (inches)	1¼ x ¾ x ½	1¼ x ½ x ½	1¼ x ¾ x ½	1 x ¾ x ½	1¼ x ¾ x ½	1½ x 1 x ½	1¼ x ¾ x ½	1 x ¾ x ½	1¼ x ¾ x ½	1¼ x ¾ x ½	1 x ¾ x ½
Flavor Comments	salty, strong butter flavor	not salty, very mild flavor	mild salt, good flavor	not salty, bland, plain	not salty, very mild flavor	just salty, strong butter flavor	just salty, mild butter flavor	just salty, good butter flavor	not salty, bland, plain	salty, good butter flavor	salty, very mild flavor

## STUDENT AWARDS AT THE 48<sup>TH</sup> ANNUAL MEETING OF THE IDAHO ACADEMY OF SCIENCE

### Poster Session

First Place	Travis Guy	Albertson College of Idaho
Second Place	Timothy Hatten	University of Idaho
Third Place	Thomas Gebrenegus	University of Idaho

### Undergraduate Oral Presentation

First Place	Shalimar T. Frost	Albertson College of Idaho
Second Place	Jadd Shelton	Brigham Young University- Idaho

### Master's Oral Presentation

First Place	Elayne M. Hovde	University of Idaho
Second Place	Carl Chakravarthy	Idaho State University
Third Place	Jennifer Stephens	University of Idaho

### Ph.D. Oral Presentation

First Place	Caren S. Goldberg	University of Idaho
Second Place	Shannon Donovan	University of Idaho
Third Place	Niko Balkenhol	University of Idaho

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## INVITED LECTURES

### PUBLIC LECTURE

#### **Addressing the Threat of Invasive Alien Plants: a Blueprint for National Action**

**Richard N. Mack**

School of Biological Sciences, Washington State University,  
Pullman, WA 99164.

Invasions by harmful alien (non-native) species are increasing in number and area affected; consequently, the toll to ecosystems, economic activity, and human welfare is accelerating. Needed is a more deliberate and comprehensive program under federal leadership, with the cooperation of state and local governments and the public, to combat these pests.

A blue print to meet this threat effectively can be organized into six recommendations: (1) Employ new practices to reduce the transport and release of potentially harmful species along commercial and other pathways; (2) Adopt new, more quantitative procedures for risk analysis and apply them to every species proposed for importation into the U.S.; (3) Use new, more cost effective diagnostic tools to increase active surveillance of invasive species; (4) Create new legal authority and provide emergency funding to support rapid responses to emerging invasions; (5) Provide incentives for cost effective programs to slow the spread of existing invasive species in order to protect still uninvaded ecosystems, property, and human welfare; (6) Establish a National Center for Invasive Species Management to coordinate and lead improvements in federal, state, and international policies on invasive species.

Many of the tools and best practices to accomplish these goals are already available; others are needed but their development is feasible. Most important will be public awareness of the costs that will be incurred by all, unless a deliberate, comprehensive approach is taken.

### KEYNOTE ADDRESS

#### **The Art of Using Science to Solve Natural Resource Conservation Problems**

**Mary Ruckelshaus**

Northwest Fisheries Science Center, NOAA Fisheries

Humans value natural ecosystems for many reasons—we want to be able to drink clean water, breathe fresh air, grow food to eat, hunt, fish, extract timber, oil and gas, go hiking, or just look out the window and find solace in a spectacular landscape. Increasingly, competing demands on natural systems are forcing conflicts among potential users to the fore. Policy makers and managers charged with making the difficult decisions about how to balance such competing objectives often look to science for help. Indeed, many statutes guiding management of species and habitats explicitly state that decisions about actions are to be ‘science-based’. All too often, communication is poor between scientists who best understand how natural systems work and managers setting policies for how people can use natural systems. Furthermore, because human activities are

the focus of most management decisions aimed at protecting natural systems, developing strategies to manage natural resources requires the good thinking of natural and social scientists. The challenge of conserving Pacific salmon under the Endangered Species Act epitomizes many of the multi-use conflicts described above, where landowners and environmentalists, commercial, recreational and tribal fisherman, pro growth and status quo advocates all have entered the fray. In Puget Sound, where 3 species of anadromous salmonids are federally listed, scientists, policy-makers, and local watershed groups have worked together in a collaborative process to develop a broadly supported recovery plan for the salmon. The philosophy underlying the approach in Puget Sound was to use science to set recovery targets for the fish, and then to ask the people most affected by the steps necessary to recover the fish what commitments they would make toward that end. Natural and social scientists then conducted analyses to estimate the outcomes of alternative recovery strategies for the salmon, and to estimate the costs of different actions. By focusing scientific analyses on how best to present distributions of likely outcomes of recovery actions and using scenario analyses to bracket potential population responses, the policy makers at watershed and regional levels were able to use scientific results to inform choices about scientifically defensible strategies. The science of salmon recovery involves conducting research to inform ongoing activities and to further our understanding of the complex linkages between salmon and their natural and human-influenced environments. The art of salmon recovery involves recognition on the part of scientists and policy makers that science can help design and evaluate recovery strategies in the face of many gaps in our understanding.

## PAPER SESSION ABSTRACTS

### SCIENCE ACROSS MANY BOUNDARIES

#### Lessons from an interdisciplinary team-based Ph.D. program in sustainable production and conservation biology at the University of Idaho and CATIE

**N. A. Bosque-Pérez<sup>1</sup>, S. D. Eigenbrode<sup>1</sup>, J. E. Force<sup>2</sup>, L. Waits<sup>3</sup>,  
B. Finegan<sup>4</sup>, C. Harvey<sup>4</sup>, J. Jones<sup>4</sup>, D. Stoian<sup>4</sup>, J. Boll<sup>5</sup>, S. Brunsfeld<sup>2</sup>,  
P. McDaniel<sup>1</sup>, M. O' Rourke<sup>6</sup>, and J. D. Wulfhorst<sup>7</sup>**

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<sup>3</sup>Department of Fish and Wildlife, University of Idaho.

<sup>4</sup>Tropical Agricultural Research and Higher Education Center, Costa Rica.

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<sup>6</sup>Department of Philosophy, University of Idaho.

<sup>7</sup>Department of Agricultural Economics and Rural Sociology, University of Idaho.

Achieving sustainable production and biodiversity conservation in anthropogenically fragmented landscapes, requires scientists educated in a holistic fashion that emphasizes interdisciplinary collaboration and team work. Traditional graduate programs in agriculture, forestry and conservation biology fall short of this goal as they educate scientists with research skills in narrowly defined disciplines and rarely facilitate integration across disciplines. We discuss some of the lessons learned from a National Science Foundation Integrative Graduate Education and Research Traineeship (NSF-IGERT) funded project in graduate education that develops and evaluates an integrative educational model with an emphasis on developing interdisciplinary team research skills and knowledge in the biological, physical and social sciences. This educational program involves researchers and educators from eight departments and three colleges at the University of Idaho and two research areas at the Tropical Agricultural Research and Higher Education Center (CATIE) in Costa Rica. Eighteen Ph.D. students currently work in five interdisciplinary teams conducting research in sustainability of agricultural and forestry production and conservation biology in temperate and tropical ecosystems in Idaho and Costa Rica. The nature, challenges and successes of this graduate program will be discussed.

#### **NASA and the Four Mission Directorates – How You Too Can Become Involved in the Mission**

**Jean A. Teasdale**

Director, NASA Idaho Space Grant Consortium & NASA Idaho EPSCoR Program

Assistant Dean, Research and Student Outreach - College of Engineering, University of Idaho

The National Aeronautic and Space Administration (NASA) is currently defined through efforts completed in response to four main themes, or “Mission Directorates.” These Mission Directorates include Aeronautics, Exploration Systems, Science and Space Operations. The overall goals and efforts of each Mission Directorate will be presented; then, Dr. Teasdale will address how

researchers of all fields can become involved with the research needs of NASA right here in Idaho. Current research conducted with NASA through the NASA Idaho Space Grant Consortium and NASA Idaho EPSCoR program will be used as examples of the interdisciplinary nature of NASA research, to demonstrate the multiple disciplines currently involved in NASA research in Idaho, and to demonstrate how more involvement is needed. This discussion will provide participants with an understanding of how NASA and Mission Directorates approach research, opportunities currently available in Idaho, and how NASA strives to use an interdisciplinary approach to learn more about the Earth and beyond.

## **The Practice of Medicine as a Public Health Initiative**

**Gary Hopkins**

Director, Institute for Prevention of Addictions, Andrews University, Berrian Springs, MI, and Assistant Director of Health Ministries, School of Public Health, Loma Linda University, Loma Linda, CA.

Physicians are generally the first to evaluate persons whose health may be at risk due to dangerous behaviors. Since physicians are generally well trained in identifying and treating health related conditions they may often be viewed as having specific expertise relative to behaviors. This assumption is likely not correct. Physicians are often not well informed regarding the complexities of behavioral change theory and may assume that informing patients of the need to modify behaviors is sufficient. The belief often has been that patients will translate accurate health/medical information provided by physicians into behavioral change. Public health research often borrowing from work of social and behavioral psychologists are generally aware that information is not a sufficient strategy when employed alone to result in behavior change. This presentation will focus on research demonstrating that accurate scientifically based health information when provided as a stand-alone strategy is not sufficient to promote behavior change. In addition, the presentation will also suggest how public health research on best practices for promoting behavioral change may be incorporated into the clinical arena to better provide physicians and communities with empirically verified strategies useful both in prevention and treatment of high behaviors known to be associated significant destructive health consequences.

## **Genetics and Evolution of the Inland Mesic Forest Ecosystem**

**Jack Sullivan<sup>1</sup> and Steve Brunsfeld<sup>2</sup>**

<sup>1</sup>Department of Biological Sciences, Box 443051, University of Idaho, Moscow, ID, 83844-3051.

<sup>2</sup>Department of Forest Resources, University of Idaho.

The increasing availability of genetic data, advances in analytical methods and bioinformatics tools enable initial assessments of the evolutionary history of an ecosystem. We examine the evolution of mesic forest ecosystems in the Pacific Northwest in four animal and two plant lineages. Three a priori hypotheses, which explain the disjunction in the mesic forest ecosystem with either recent dispersal or ancient fragmentation, are tested with phylogenetic and coalescent-based methods. There is strong support in three amphibian lineages for deep divergence between coastal and inland populations, as predicted by the ancient fragmentation hypothesis. However, the disjunction in other PNW lineages resulted from

post-Pleistocene dispersal along a northern route in water voles, dusky willow, and whitebark pine. These analyses demonstrate that genetic data from across an ecosystem can provide a historical context to the study of ecological communities. Genetic patterns in organisms as diverse as willows and salamanders can be difficult to compare, but sequence data can be collected from each species, and tests of common hypotheses provide a consistent metric for comparison among members of an ecosystem with disparate life-history traits.

Keywords: phylogeography; genetic variation; ecosystem.

### **Funding Science Across the Boundaries: The National Science Foundation role in The American Competitiveness Initiative**

**James Gosz**

The National Science Foundation, 4201 Wilson Blvd. Arlington, VA 22230 and The University of Idaho.

The President's budget for fiscal year 2007 requests an increase of \$439 million for NSF as a part of the President's American Competitiveness Initiative to double the budget of NSF over 10 years. Legislation has been introduced for Protecting America's Competitive Edge (PACE), which calls for doubling research and development funding and a tremendous investment in education. The legislation was crafted to implement 20 recommendations outlined in "Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future," a National Academies of Science report. One of NSF's strong points is multidisciplinary integration at the frontier, where disciplinary boundaries blur and knowledge converges. Increased funding and new programs are planned to capitalize on this renewed investment for "Frontier Research" that span Biological, Geological, Social/Economic, Computational, and Engineering disciplines and can be important opportunities for research/education efforts in Idaho. The presentation will identify new opportunities for planned for funding Frontiers in Integrative Biological Research, National Ecological Observatory Network (NEON), Biology in Engineering, Complexity in Engineered and Natural Systems, frontier research in Sensors/Sensor Networks, Biological-geosciences, and the Strength Based Collaborative Research (SBRC) program of NSF EPSCoR.

Keywords: NSF; funding; frontier research.

## SCIENCE ACROSS THE BOUNDARIES: NATURAL RESOURCE CONSERVATION AND SUSTAINABLE PRODUCTIVITY

### Interdisciplinary efforts in outreach, education and research at the Center For Research on Invasive Species and Small Populations

George Newcomb<sup>1</sup>, Lisette Waits<sup>2</sup>, and Cort Anderson<sup>2</sup>

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We recently established the Center for Research on Invasive Species and Small Populations (CRISSP) with the goal of using interdisciplinary scientific research to identify appropriate management actions for addressing the biological and economic challenges of invasive species and small and declining populations. CRISSP has assembled a team of 24 participating faculty from diverse disciplines in biological sciences, and social sciences and an advisory board of regional land managers. The mission of CRISSP is to integrate research, education and outreach efforts, in order to facilitate the development of innovative research, graduate and undergraduate education and training programs, and collaboration with regional government and private land management efforts. This presentation will overview the organizational structure of our Center and current research, education and outreach efforts.

Keywords: invasive species; conservation; natural resource management.

### The Palouse: Using Interdisciplinary Research to Develop Conservation Strategies in a Working Landscape

Shannon Donovan<sup>1</sup>, Christopher Looney<sup>1</sup>, Yaniria Sanchez-de Leon<sup>2</sup>,  
Thor Hanson<sup>3</sup>, and Tim Hatten<sup>2</sup>

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The Palouse is a cultural landscape dominated by agricultural fields. Due to expanding agricultural practices, less than one percent of the native Palouse prairie remains intact. There are no land use policies currently aimed at protecting the remaining prairie remnants. However, these remnants face continued threats from development, grazing, and invasive species. Although interest in conserving the native Palouse ecosystem has increased, a systematic assessment of attitudes and perceptions among landowners and stakeholders has yet to occur.

Through the IGERT project at the University of Idaho, an interdisciplinary team is working to develop conservation options for the Palouse aimed at balancing stakeholder values with biological conservation needs. We are using Geographic Information System to look for areas of convergence between biophysical, ecological and social areas. The resulting maps will be used to:

- Document areas of high native biological diversity, and determine how these are affected by landscape context
- Discover if spatial connections exist between areas of high native biological diversity and stakeholders' perceptions of their landscape
- Provide a flexible tool that can be used by stakeholders and regional planners to explore and interpret regional landscapes
- Develop a framework for conservation planning in fragmented landscapes.

Keywords: Palouse; prairie; conservation.

### **Predicting patterns and impacts of landscape change in northern Idaho based on private landowner decisions across an urbanizing agricultural and forested landscape**

**Caren S. Goldberg<sup>1</sup>, Max Nielsen-Pincus<sup>2</sup>, Amy Pocewicz<sup>2</sup>, Melanie H. Johnson<sup>3</sup>, I.isette P. Waits<sup>1</sup>, Penelope Morgan<sup>2</sup>, Jo Ellen Force<sup>2</sup>, and Lee Vierling<sup>4</sup>**

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Exurban development and other related changes in land use across Latah and Benewah counties (4763 km<sup>2</sup>) of northern Idaho typify changes occurring throughout much of the American West. The primarily privately-owned, mixed forested and agricultural landscape of this region is experiencing increased residential development and changing land management strategies due to shifting socioeconomic conditions. Using a stratified random sampling design, we collected data by mail survey from 442 landowners on the probabilities of changing their land to specific other land covers (e.g., forest to development) in the next 5-10 years. In addition, we collected data on policy barriers and facilitators for certain land conversions. We are using these data to develop models predicting land cover and landscape configuration under current conditions and with proposed policy changes. In parallel with this effort, we have been collecting data to model the relationship between landscape configuration and habitat for multiple species and ecological processes, and the social acceptability of particular landscape changes. We will use the probabilistic models of predicted landscape configuration and these habitat, ecological, and sociological models, as well as models developed by other researchers for criteria such as fire hazard, to investigate the future of the landscape of northern Idaho.

Keywords: landscape; model; alternative futures.

## **Sustaining Ecosystems and People: A Multi-disciplinary “Policy Sciences” Framework**

**Jay O’Laughlin**

College of Natural Resources, University of Idaho, Moscow ID 83844-1134.

People expect natural resource systems to provide an array of ecological and environmental goods, services, and values as well as food and fiber commodities. Policies that harmoniously balance environmental conservation and economic development of resources to meet human needs are necessary but elusive. The sustained yield commodity production goal that served land and resource managers for centuries evolved following the 1987 international call for sustainable development. A more fully integrated “sustainability” approach will be next. Toward that end, the ecological, economic, and social dimensions of sustainability can be assessed using scientific methods, but integration remains problematic. Biologist E.O. Wilson’s Consilience took a step, arguing for synthesis of knowledge; I continue in that direction. The larger the spatial scale at which one conceives sustainable resource management, the more difficult the quest becomes. When coupled with ecological and economic dimensions, stakeholders’ perceptions of the fairness of resource management proposals can help identify paths toward sustainability. Inclusive forums where stakeholders interact with land and resource managers in collaborative learning exercises can be an appropriate starting point, but durable issues remain: Who represents future generations? How can broad social perspectives be reconciled with local concerns?

Keywords: economics; ethics; governance.

## **Truth or Consequences: Natural Resource Dispute Resolution in the Face of Uncertainty**

**Barbara Cosens**

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Negotiations to resolve intergovernmental natural resource issues occur in the face of both legal and scientific uncertainty. In 2005, the Nez Perce Tribe, State of Idaho, and United States settled the water right claims of the Tribe, including off-reservation in-stream flow rights stemming from the treaty right to fish at the “usual and accustomed places” encompassing much of the Salmon and Clearwater basins. The U.S. Supreme Court has not ruled on whether treaty fishing rights translate to instream flow water rights. Thus, considerable legal uncertainty surrounded these claims. At the same time, arriving at a negotiated solution pitched the parties into the decades-long scientific struggle to define the needs of anadromous and resident fish in the Columbia River basin. The final settlement includes numerous measures aimed at restoring and protecting salmon habitat, including state-held in-stream flow rights. This paper uses the Nez Perce water negotiations as a case study for analysis of the differing roles of legal and scientific uncertainty in natural resource dispute resolution concluding that in this setting, the divergence between law and science -- one toward finality, one toward the truth -- may create barriers to achievement of a settlement if not addressed in negotiation.

Keywords: reserved water rights; dispute resolution; salmon.

## **Interdisciplinary Research in Landscape Genetics and Applications for Natural Resource Conservation**

**Lisette Waits<sup>1</sup>, Stacie Robinson<sup>2</sup>, Niko Balkenhol<sup>1</sup>, Caren Goldberg<sup>1</sup>,  
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The new field of landscape genetics merges state-of-the-art technological advances in landscape ecology, population genetics, and spatial statistics to provide new approaches for understanding how landscape features influence genetic variation and structure. This new discipline has important applications for ecology, evolution, conservation biology, and the management of natural populations. From a basic science perspective, researchers can test explicit hypotheses regarding landscape processes or features that shape population genetic structure. Understanding landscape effects on genetic connectivity improves insight into fundamental biological processes such as metapopulation dynamics and speciation. Landscape genetic analyses also have substantial applied scientific value. For example, landscape genetic methods can be used to identify populations, detect barriers, and predict effects of management actions on connectivity among populations. Landscape genetics can be very useful for the design of protected areas and corridors by helping researchers understand what geographic features facilitate and impede movement. However, the development and application of landscape genetic approaches are currently hindered by challenges of communication and knowledge exchange among the three major disciplines, and multiple questions regarding optimal sampling and analysis methods remain unresolved. Our interdisciplinary research group will overview the development of this new field, application for natural resource conservation, and future directions.

Keywords: landscape genetics; gene flow; connectivity.

## **SCIENCE ACROSS MANY BOUNDARIES**

**Think Blue Marble**

**Jill Dacey and Frank Cronk**

Department of Art and Design, University of Idaho, Moscow, ID 83844-2471.

“A picture is worth a thousand words”—or a picture might elicit a thousand words. Just as the Blue Marble of Earth view from space generated global excitement about space and gave us information and knowledge, visuals are one of the best ways to help us think about science. It is also one of the best ways to relate research results to the general public. Information design/visualization can be used to look at data in a new way, to help others understand concepts, and to develop excitement about science and scientific discovery. Making information accessible and useable is the goal of information designers, whether working with scientists to look at data or helping scientists make their work accessible

to colleagues or to the general public. Yet designers are rarely included among interdisciplinary teams of researchers. We are not concerned with making pretty pictures or creating twirling chili peppers for a presentation (although we can!). We are concerned with producing products for an end-user—products that help turn data to information to knowledge. We will demonstrate how we, and our design students, can bring information design and visual thinking to the table as an ingredient in the science diet.

Keywords: visualization; information; design.

## **Enhancing Wind Power Economics**

**Jay F. Kunze<sup>1</sup> and Carl Chakravarthy<sup>2</sup>**

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Wind generation of electricity has poor utilization of a significant capital investment. Typical maximum possible capacity factors, at the best wind sites, are 32% average throughout the year. Consequently, wind-generated electricity is not considered reliable, and the price that utilities are willing to pay for the power is often not even equal to off-peak power spot rates.

Current installed costs for wind generators are in the \$1200 per kW range. With only a 32% capacity factor, at 8% interest rate over 20 years, this capital cost figure equates to a capital cost charge of 4.4 cents per kW hour. Current off-peak market wholesale power rates are in the range of 4.8 cents per kWh in the northwest (3.5 cents in the Tennessee Valley Authority area), it is difficult to justify wind generation as an economical entity without the government subsidy of 1.9 cents per kWh. (Note, maintenance and other operating costs are not included in the above figures.)

We have examined the effective capacity factor if only a fraction of the rated output of a machine were offered to the utility. In our example, a 950 kW machine was analyzed for offering only 100 kW to a utility, with any remaining power output to be utilized for hydrogen production for either replacement of natural gas or for fuel cell operation to generate on-site electricity. Using actual wind data from a ridge site near Pocatello, the analysis showed that an annual average capacity factor of about 72% would exist for the 100 kW to be offered to a utility, compared to about 25% for the rated 950 kW wind machine output. Thus, the 100 kW contract would be much more attractive.

Keywords: wind; capacity-factor; utilization.

## **Thermophysical Properties of Hydrogen as an Energy Carrier**

**Jake W. Leachman<sup>1</sup> and Richard T. Jacobsen<sup>2</sup>**

<sup>1</sup>1512 Alder Drive, Lewiston, ID 83501.

<sup>2</sup>University of Idaho.

The potential for widespread use of hydrogen as an energy carrier for transportation systems in the near future provides some engineering and technological challenges related to energy sustainability. The temperatures and pressures of the systems to generate this hydrogen may be beyond the ranges of the currently accepted thermodynamic and transport property formulations developed in the 1980's. Accurate thermophysical properties of hydrogen are needed for engineering system design and analysis to support the proposed hydrogen economy.

This paper compares calculated thermophysical properties (density, heat capacity and speed of sound) of normal hydrogen and parahydrogen with the available experimental data to illustrate the accuracy of the current formulations. Similar comparisons are given for the transport properties, thermal conductivity and viscosity.

We have included a brief discussion of the practical aspects of hydrogen chemistry associated with the storage of hydrogen under various conditions. The nature of normal hydrogen as a mixture of orthohydrogen and parahydrogen is discussed in relation to its behavior. This paper presents interim results of a research project which is part of a multi-disciplinary program involving the Center for Applied Thermodynamic Studies (CATS), the National Institute for Standards and Technology (NIST), and the American Society of Mechanical Engineers (ASME).

Keywords: Hydrogen; properties; transportation.

## **Energy System Architecture and Energy Currencies**

**Vivek P. Utgikar<sup>1</sup>, Thomas Lohkamp<sup>2</sup>, and Richard T. Jacobsen<sup>2</sup>**

<sup>1</sup>University of Idaho at Idaho Falls, 1776 Science Center Drive, Suite 306, Idaho Falls ID 83402.

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Energy system architecture is often depicted as a five component linked chain consisting of services, service technologies, energy currency, transformer technologies and energy source. This representation does not distinguish between material/energy streams and processes/operations in their representations. A modification of this architecture is proposed to enhance its clarity through clearly identifiable input-outputs, material/energy flow streams, and process/operation steps. Energy currency is a critical component of the energy system architecture, and a classification of energy currencies is also proposed in this paper. The classification is based upon the quantitative parameter, energy ratio, which is the ratio of the energy content of the currency to the energy expended to obtain that currency. The energy ratio for primary energy currencies is greater than or equal to 1, while secondary energy currencies have energy ratios less than 1. This classification is useful in avoiding pitfalls in conducting comparisons of various currencies that are utilized by similar or competing technologies to provide identical services.

Keywords: energy system architecture; energy currency; energy ratio.

## **Soluble DNA as a Forensic Target for PCR Detection and Identification of Aquatic Organisms**

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All cells release DNA when they die, but detection of rare DNA targets (e.g. < one molecule per ml) requires concentration before amplification.. Soluble DNA (sDNA) can be recovered and concentrated from water through anion exchange and used as a template for detection and identification of any biological target. Extraction and concentration of sDNA (0.2 µm filtered water) from three separate water sources was attempted: two mesothermic springs and a fish run. The two warm springs failed to yield any detectable DNA or amplifiable bacterial target. The fish run, which contained fry from several species including *Oncorhynchus mykiss* (rainbow trout) yielded DNA at 94 ng/l. The major histocompatibility complex of rainbow trout was amplified from the DNA concentrate. The utility of this approach for bio-monitoring is applicable to all DNA sources, is scalable to extremely rare targets, and should be quantifiable within narrow limitations. Research was funded by NIH P20RR16454.

Keywords: soluble DNA; bacteria; ion exchange membrane.

## **Evolutionary Science, Environmental Ethics, and Intelligent Design: Chance vs. Design, Process vs. Causality, Diversity vs. Complexity**

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Evolutionary science and theism are again at odds in the intelligent design/ evolution debate. Intelligent design proponents are attempting to impose religious aims on biology, not cognizant of the detriment its standpoints have on particularly, Christian environmental ethics. Protestant theologies will not go forward with continual insistence on ideology that has no practical relevance with how the natural world is experienced. There must be integration of evolutionary science with religion. No longer can theology afford to cling to outdated theories that subvert scientific understandings of the natural world. This paper examines the issues of design, causality and complexity that lie at the heart of the intelligent design movement and its clash with evolution's emphasis on chance, process, and patterns, and advocates that openness theology can address how the natural world is experienced without butting views with science. Openness theology's presence in the religion/science dialogue is of particular importance and offers a viable alternative for a practical environmental ethic.

Keywords: evolution; ethics; intelligent design.

## PHILOSOPHY AND NATURAL RESOURCES

### Philosophical Issues in Interdisciplinary Research

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Jennifer Stephens<sup>2</sup>, Leigh Winowiecki<sup>2</sup>, J. D. Wulfhorst<sup>2</sup>,  
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Scientific disciplines are complex human institutions, often possessing a heterogeneous character hidden behind a simple name. Even so, they typically harbor enough agreement about orientation, motivation, subject matter, and method to ease professional communication, interaction, and knowledge construction. By contrast, interdisciplinary research efforts tend to be sui generis combinations of motivation and method around broad topics. There are generally no institutional contexts or conventions guiding compromise—IDR participants speak different languages, generate conclusions in different ways, and take different things to be knowledge. For these efforts to succeed, participants must work around these differences, if not reconcile them. While this is often accomplished in ad hoc fashion, we argue that these differences are fundamentally conceptual and that philosophy can prove valuable as a tool for mediating them.

Philosophical examination of IDR reveals a complex interplay of epistemological and metaphysical factors that, taken as a systematic whole, frame the differences that hinder progress toward interdisciplinary knowledge. We aim this talk at two audiences: for scientists, we describe this philosophical framework and argue for its value in structuring scientific IDR; for philosophers, we argue that IDR supplies a rich and relatively unexplored context for the development of philosophical theory.

Keywords: interdisciplinarity; philosophy; integration.

### Philosophical Dialogue as a Tool for Success in Interdisciplinary Research

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Interdisciplinary research is required to address pressing environmental problems facing human societies. By definition, interdisciplinary research involves broad based collaborations throughout the investigative process from problem formulation and hypothesis development, to data analysis and application. This level of integration raises a number of conceptual and methodological challenges

that are new to many researchers. In this article, we develop the theme that many interdisciplinary challenges are philosophical in nature and inherently influence each stage of research. We suggest that these differences are best addressed as part of the interdisciplinary research process through an open dialogue among team members. We present a “philosophical toolbox”, consisting of a set of questions for self-examination that interdisciplinary teams can use to identify and help address their philosophical disparities and commonalities. Doing so can facilitate effective integration and improve the success of interdisciplinary research.

Keywords: interdisciplinary research; philosophy; teams.

### **Philosophy, Ecology, and Conservation Problem-Solving: A Case Study**

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This presentation will examine both the theoretical foundations and the practical dimensions of one type of interdisciplinary collaboration that fuses the work of environmental philosophy, population biology, and various natural resource conservation problems that we currently face. Questions such as; What do the inherently normative dimensions of the Endangered Species Act imply for conservation efforts?, How should we morally evaluate the work that wildlife biologists do in the name of conservation when that work involves the lethal elimination of sentient animals?, What are the ethical dimensions of wolf recovery and control?, Can we answer any of these difficult yet persistent conservation questions from within the realm of one traditional discipline only? We believe that it is only through intensely collaborative work that these problems have any chance of being addressed. The process of collaboratively working through these conservation problems seems also to have revealed some important discoveries about what it means to work in an interdisciplinary fashion on conservation problems in the first place. The presentation will roughly outline two or three of these collaborative projects and then move to a brief theoretical outline of the nature such an interdisciplinary collaboration.

Keywords: conservation biology; interdisciplinary; philosophy.

## **CS2 — INVASIVE SPECIES**

### **Grazing by Cattle and Sheep Affect Yellow Starthistle on Idaho Rangelands**

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Since the introduction of yellow starthistle (*Centaurea solstitialis*) to North America in the late 1800's it has become one of the West's most detrimental weeds to rangeland and recreational areas. We assessed the effects of prescribed grazing by sheep and cattle on yellow starthistle in the rosette, bolting, and flowering

stages with an ungrazed control. A three-year grazing trial was implemented on a starthistle-infested site on the breaks above the Clearwater River near Lewiston, Idaho. Field observations revealed that sheep grazed starthistle throughout the growing season. Cattle grazed starthistle in the rosette and bolting but avoided plants during flowering when spines started forming. Prescribed livestock grazing has often been applied to accomplish weed management. However, in our study, yellow starthistle densities were higher in all grazing treatments compared to ungrazed paddocks. Increased plant density resulted in an increased number of flowers/m<sup>2</sup> in grazed paddock at the end of the season. Grazing while yellow starthistle was in the rosette yielded the greatest plant density, with lower densities when grazing occurred in the bolting or flowering stages. Paddocks grazed by cattle had greater starthistle densities than those grazed by sheep. Grazing had few detectable effects on cover of grasses or forbs.

Keywords: grazing; invasive plants; weed management.

### **ESA Snail Monitoring Activities in the Mid-Snake River, Idaho**

**William H. Clark**

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Idaho Power Company (IPC) and U.S. Fish and Wildlife Service have worked in a cooperative manner resulting in a February 2004, settlement agreement with the Federal Energy Regulatory Commission pertaining to five Mid-Snake River hydroelectric projects. This study addresses one of five information needs relating to the Bliss Rapids snail (BRS) (*Taylorconcha serpenticola*) and the Idaho springsnail (*Pyrgulopsis idahoensis*) and the potential impacts of IPC's operations on these two species. Information need (IN) one includes the depth distribution of the snails and the river stage height vs. snail distribution. IN 2 involves laboratory and field studies of the dewatering impacts on the listed snails. Laboratory studies of BRS indicate that the snails can survive many hours under most conditions above freezing. IN 3 requires sampling of snail abundance in various river habitats and then an assessment of the river habitats available for snails. BRS was found in more than 70% of river reaches searched. IN 4 is population viability analysis and risk assessment for the two snail species. IN 5 is a survey of listed snail occurrence and abundance in tributary springs and streams into the Mid-Snake River. We are finding them in over 50% of the areas searched.

Keywords: ESA-listed snails; Middle Snake River; Bliss Rapids Snail/Idaho Springsnail.

## CHEMISTRY

**Fluorine-containing Ionic Liquids: Synthesis, Properties and Applications****Haixiang Gao<sup>1</sup>, Ji-Chang Xiao<sup>2</sup>, Chuanming Jin<sup>3</sup>, Chengfeng Ye<sup>1</sup> and Jean'ne M. Shreeve<sup>1</sup>**<sup>1</sup>Department of Chemistry, University of Idaho, Box 442343, Moscow, ID 83844-2343.<sup>2</sup>Shanghai Institute of Organic Chemistry, Shanghai, China.<sup>3</sup>Hubei Normal University, Huangshi, China

Ionic liquids (ILs) are a class of organic salts with a wide range of liquidus temperatures and intrinsically useful characteristics of low melting point, negligible vapor pressure, thermal stability, low coordinating ability, and excellent thermal and chemical stability. These properties make them attractive alternatives to traditional solvents, catalysts, electrolytes for batteries, and even as advanced heat transfer fluids, and lubricants, etc.<sup>1</sup> One advantage of ionic liquids is their tunable physical properties. Introduction of fluorine into an ionic liquid can change its polarity, viscosity, density, melting point, miscibility/solubility and sometimes results in unexpected properties. Ionic liquids with a fluorine-containing anion or cation have attracted a great deal of attention in recent years.<sup>2</sup> As part of our ongoing research aimed at synthesis, characterization and applications of fluorine-containing ionic liquids, we recently explored a series of new fluorine-containing compounds.

<sup>1</sup> Ionic liquids in Synthesis; Wassercheid, P., Welton, T., Eds. ; Wiley-VCH: Weinheim, 2003.<sup>2</sup> a) Xue, H. ; Verma, R.; Shreeve, J. M. J. Fluorine Chem. 127, 2006, 159–176; b) Xue, H. ; Shreeve, J. M. Eur. J. Inorg. Chem. 2005 (13): 2573-2580.

Keywords: fluorine; ionic liquids; solvent.

**Fluorine-containing Ionic Liquids: Syntheses and Properties****Ye Gao and Jean'ne M. Shreeve**

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While imidazolium salts dominate the ionic liquid field, new liquid salts comprised of polyfluoroalkyl or pentafluorosulfanyl polyfluoroalkyl-substituted triazolium, pyridinium, pyridazinium, pyrazinium, pyrimidinium, morpholinium, oxalidinium and trialkylammonium cations have been shown to have high thermal stabilities, high densities, long liquid ranges, low moisture sensitivity, and varying viscosities. Bis(trifluoromethanesulfonyl) amide as the anion in these salts contributes markedly to lowering the melting points when compared with tetrafluoroborate, triflate, or hexa-fluorophosphate. Interestingly, perfluoroalkyl diketones protonate cyclic and acyclic alkylamines to give low melting salts with low densities and, in some cases, viscosities approaching that of water. The impact of either the bis(trifluoromethanesulfonyl)amide anion or the perfluoroalkyl &#946;-diketonate anion on the melting points of these quaternary salts results from considerable delocalization of the electron cloud over the molecular backbone. Some of these ionic liquids have been demonstrated to have useful practical applications.

Keywords: fluorine; ionic liquids; bis(trifluoromethanesulfonyl) amide.

### **High Nitrogen Energetic Salts as Propellants**

**Hong Xue and Jean'ne M. Shreeve**

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High nitrogen energetic salts comprised of substituted 1, 2, 4-triazolium cations and 4, 5-dinitro-imidazolate and 5-nitrotetrazolate / or nitrate and perchlorate anions, were synthesized and characterized. The structures of 1, 2, 4-triazolium 5-nitrotetrazolate, 4, 4'-bi(1, 2, 4-triazolium) nitrate, N, N-dimethyl-N'-(5-methyl-tetrazole)methanimidamide, and N-4-(1, 2, 4-triazole)-N-3-(4-methyl-1, 2, 4-triazolium)amine perchlorate were confirmed by single crystal X-ray analysis. The physical properties and heats of combustion of the new salts were measured and the heats of formation were also determined.

Keywords: energetic salts; propellants; heats of formation.

### **Bromination and Iodination Reactions Mediated by Selectfluor**

**Chengfeng Ye and Jean'ne M. Shreeve**

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In less than two years, Selectfluor has been the subject of three major reviews. Although it is most often employed as an extremely effective electrophilic fluorinating reagent, it also plays an important role in the mediation or catalyst of additional organic synthesis. A number of olefins were oxidatively brominated using Selectfluor / KBr. For different types of reactants with unsaturated carbon-carbon bonds, addition, monobromine-substituted, or decarboxyl-bromination products were readily formed. The products strongly depend on the structures of the olefins. Hyper-valent iodine (III) containing compounds, such as aryl iodine difluoride, diacetate or Kosher's reagent, can be obtained easily in good yields by reaction of aryl iodide and Selectfluor. Mediated by Selectfluor, aryl iodine difluoride or diacetate can be prepared conveniently by the direct reaction of arene, and I<sub>2</sub> in a one-pot procedure.

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Stavber, S.; Zupan, M. *Acta Chim. Slov.* 2005, 52, 13-26.

Keywords: iodination; bromination; Selectfluor.

## High Yield Synthesis and Lithography of Silica-based Nanosprings

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In this study we report a novel technology for synthesizing silica-based nanosprings with a yield higher than 90% and with 100% repeatability. The nanospring mats are grown via the liquid-vapor-solid mechanism using a gold catalyst, where the deposition temperature can be as low as 350°C. XPS analysis shows that the as-grown nanosprings have components of silicon and oxygen with an atomic ratio close to silica. Both SEM and TEM images illustrate that the helical structure of the nanosprings is extremely uniform. Two types of nanosprings are observed using TEM. The first type of silica nanospring is formed from a single nanowire, while the second type consists of multiple intertwined nanowires. Patterned deposition of nanosprings has been achieved using this technology.

Keywords: nanospring; silica; lithography.

## SOILS AND AGRICULTURE

### Investigating the Potential of <sup>31</sup>P-NMR to Probe Interactions between Humic Material and Inorganic Phosphorous

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<sup>2</sup>University of Idaho.

<sup>31</sup>P-NMR measurements were used to investigate the role played by humic materials in the retention/mobilization of inorganic phosphorous (Pi) in the subsurface. Humic Acids were isolated from a number of different soils and subsequently interacted with metals native to these soils in order to generate metal-humate complexes. These complexes, both in the solid phase and in solution were then exposed to aqueous Pi and subjected to <sup>31</sup>P-NMR measurements. Preliminary results suggest that analysis of resonance peak anisotropy provides relevant information regarding the mobility of Pi. <sup>31</sup>P-NMR appears to be an effective tool in probing the interactions between metal-humate complexes and Pi, providing information regarding the mobility of Pi.

Keywords: humic materials; nuclear magnetic resonance.

## **Reduction of Inorganic Arsenic with Humic Materials**

**Noel Palmer and Ray von Wandruszka**

University of Idaho, Moscow, ID 83844.

In natural systems, arsenate (As-V) can be reduced to arsenite (As-III) through a number of different reaction mechanisms. The goal of this research is to study the abiotic reduction of arsenate through the intervention of different humic materials. Results indicate that arsenate can be reduced in varying degrees depending on the humic composition, concentration and solution pH. In this work, the reduction potentials for several humic acids was studied. These humic acids were used as reducing agents for inorganic arsenic. While all the arsenate is never completely reduced to arsenite by these humic materials, the amount of total reduction can range from 20 to 60%. Results have also indicated that the kinetics of this reaction can be quite slow, with complete reduction often taking up to 48 hours.

Keywords: humic; arsenic; reduction.

## **On-Farm Study of Nitrogen Mineralization with Implications for Nutrient Management and Water Quality**

**Mir M. Seyedbagheri**

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Proper nutrient management is essential to prevent nitrate contamination of ground and surface water resources. Nitrogen mineralization is the process by which soil microorganisms convert organic nitrogen to inorganic nitrogen. Since mineralization provides a substantial amount of inorganic nitrogen to the agroecosystem, it is important to understand and quantify this process under different cropping systems. The time course of mineralization has important implications for water quality because it contributes to the soil nitrate pool throughout the growing season.

Nitrogen mineralization was studied with the buried bag method in potato and sugarbeet fields in southwest Idaho. In potato fields, more detailed studies were conducted comparing conventional and organic production systems. Compost trials were conducted in both systems, and a rapeseed meal study was conducted on an organic field. This information will allow the development of better crop management practices that satisfy crop demand for nitrogen without leaving excess nitrates that may be leached into groundwater or washed into surface water.

Keywords: Nitrogen; mineralization; water quality.

## Bacterial Nitrate Depletion Along a Particulate Matrix Flow Path

Jadd Shelton<sup>1</sup>, Stephen Bent<sup>2</sup>, and Larry Forney<sup>2</sup>

<sup>1</sup>Brigham Young University – Idaho. <sup>2</sup>University of Idaho.

### Nitrate Depletion by Bacterial Anaerobic Respiration along a Particulate Flow Path

The study of bacterial growth, both planktonic and in biofilms, is relevant to Ecology and Medicine. We utilized a laboratory-scale microcosm to aid our understanding of the patterns of bacterial-growth dynamics in a spatially heterogeneous environment along a nutrient gradient. Our primary tested hypothesis was: Nitrate depletion by bacterial anaerobic respiration along a particulate matrix flow path corresponds with growth parameters of the bacterial strain. Measured parameters for each strain of *Shewanella putrefaciens* and of the culture system were used to build an adapted mathematical model that was tested against empirical data. The strains reduced nitrate to nitrite along the flow path, corresponding to the model. However, a discrepancy exists between predicted biomass numbers from the model and actual biomass data. These discrepancies can be explained by uneven biomass distribution and dead and dormant cells. This project was funded by NIH P20RR016454.

Keywords: bacteria; nitrate; depletion.

## Prospects for Commercial Managed Production of Idaho's State Fruit, Mountain Huckleberry

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Idaho's state fruit, mountain huckleberry (*Vaccinium membranaceum*), served as a food staple and trade good for northwestern Native Peoples and demand for the fruit remains strong today. Fresh and frozen berries are sold to local and distant markets, including Pacific Rim countries. Processors create diverse culinary products targeting tourist and gift trades and huckleberry specialties are popular in restaurants. Most huckleberry crops are harvested from unmanaged native colonies, largely on public lands in the Northwest. Coincident with increased demand has come reduced access to native colonies due to forest road closures. Private development of forest lands formerly open to the public has also limited access to productive colonies. Timber and fire management policies have encouraged the development of dense tree canopies and intense forest fires, both of which reduce huckleberry numbers and productivity. Efforts are underway to produce mountain huckleberry in sustainable, managed forest stands and in field cultivation. Varietal selections are being tested, as are model production systems. Cooperating growers are establishing experimental plantings and the first crop was harvested from a managed forest stand in 2005. Goals are to provide economic benefits to the region by meeting commercial demands while conserving the biodiversity and health of native ecosystems.

Keywords: *Vaccinium membranaceum*; black huckleberry; thin-leaved huckleberry.

## CHEMISTRY

**Design and Decomposition of Cyclopentadienyl Gallium Azo Compounds: A Potential Route to Gallium Nitride Materials****Philippe Perrotin<sup>1</sup>, Pamela J. Shapiro<sup>1</sup>, and Brendan Twamley<sup>2</sup>**<sup>1</sup>Dept. of Chemistry, University of Idaho, 116 Renfrew Hall, Moscow, ID 83844-2343.<sup>2</sup>University Research Office, University of Idaho.

Gallium nitride is a wide bandgap (3.45 eV) direct semiconductor with a high thermal and chemical resistance. GaN is valued for its application in optoelectronic devices operating in the blue, violet and ultraviolet regions of the optical spectrum.

Our approach to synthesize gallium nitride is through the solvothermal decomposition of organometallic precursors containing azo ligands. In designing our precursors, we exploited the labile nature of the gallium cyclopentadienyl bonds (cyclopentadienyl: C<sub>5</sub>R<sub>5</sub>-), which are much easier to cleave than other Ga-C as well as Ga-H bonds. Details about the structures, thermal and photochemical decomposition of these compounds will be presented.

Keywords: gallium nitride; organometallic; nanomaterials.

**GEOLOGY, BIODIVERSITY, ENVIRONMENTAL TOXICOLOGY,  
HYDROLOGY****Geology and Petrogenesis of the Oligocene East Tintic Volcanic Field, Utah****Daniel K. Moore, E.H. Christiansen, and Douglas Scott Flamm**

Brigham Young University – Idaho.

The early Oligocene East Tintic volcanic field is located in the East Tintic Mountains of central Utah and consists of volcanic and shallow intrusive rocks associated with the formation of composite volcanoes and small, nested calderas. Magmatism occurred during 6 phases (from oldest to youngest): Fernow Quartz Latite, Rock Canyon group, Sunrise Peak group, shoshonite-trachyte and Dry Herd Canyon group, second episode of Rock Canyon group, and second episode of Sunrise Peak group. 40Ar/39Ar ages indicate that magmatism began in the East Tintic volcanic field no later than  $34.71 \pm 0.19$  Ma and ended no earlier than  $32.70 \pm 0.28$  Ma. The igneous rocks of the field are calc-alkaline, potassic, silica-oversaturated, and metaluminous and can be categorized into two magmatic series: shoshonite-trachyte and intermediate. The shoshonite-trachyte series evolved by fractional crystallization. The high K<sub>2</sub>O, Rb, and Al<sub>2</sub>O<sub>3</sub>/CaO ratio of this series appear to result from extensive, high-pressure fractional crystallization of clinopyroxene. Assimilation appears not to have been important for this series. All groups of the intermediate series evolved by magma mixing and simultaneous fractional crystallization and can be divided into 3 groups based on phenocryst assemblage: Rock Canyon, Sunrise Peak, and Dry Herd Canyon.

Keywords: Tintic; Oligocene; petrogenesis.

## **Biodiversity of Desert Ants (Hymenoptera: Formicidae) at Big Bend National Park, Brewster County, Texas, A Progress Report**

**William H. Clark**

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The desert ants (Hymenoptera: Formicidae) of Big Bend National Park, Brewster County, Texas, are not well known. The objectives of this research are to document the ant species present in the desert and note ecological relationships including myrmecophiles. Preliminary findings include the results of six collecting trips to Big Bend since the summer of 2000. I have found five subfamilies of ants to date: *Myrmicinae*, *Formicinae*, *Dolichoderinae*, *Ponerinae*, and *Pseudomyrmicinae*. I estimate that there may be 75 species of desert ants in the Park. Ant guests that I have collected include silverfish, *Mirolepisma*, and the rare beetles *Cremastocheilus* and *Araeoschizus*. Little is known about the biology of these guests and their relationships with their host ants. I have collected seven *Pogonomyrmex* harvester ant species including *P. bigbendensis*, which is not well known. I have helped document the infestation of the red imported fire ant (*Solenopsis invicta*) from a park campground, and have done surveys to record its spread.

Keywords: biodiversity; ants; Big Bend National Park, Texas.

## **The Use of Piscine Cell Lines in Environmental Toxicology: A Study of Cadmium-Induced Apoptosis in RTgill-W1 and RTL-1 Cells**

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Cadmium is a known environmental contaminant. The introduction of cadmium into Idaho's ecosystems makes understanding its toxic effect on organisms important. While the cellular mechanisms through which cadmium acts are unclear, it is our hypothesis that cells display a differential sensitivity to cadmium and death occurs through apoptosis. Rainbow trout gill (RTgill-W1) and rainbow trout liver (RTL-1) cells were treated with 200  $\mu\text{M}$  or 500  $\mu\text{M}$   $\text{CdCl}_2$  for 3, 12, 24 or 48 hours. Cells were evaluated using trypan blue and phase-contrast microscopy. Cell counts were conducted on the supernatant to evaluate loss of adherence. All assays indicated RTgill-W1 cells were more resistant to cadmium toxicity compared to RTL-1 cells. To evaluate the role of apoptosis in this differential response, DNA fragmentation was assessed using Hoechst staining. There was no detectable DNA fragmentation in RTgill-W1 cells treated with 200  $\mu\text{M}$   $\text{CdCl}_2$  at 48 hours, in contrast a significant increase in DNA fragmentation occurred in RTL-1 cells. These data indicate cells respond differently to cadmium toxicity, and for the RTL-1 cells apoptosis may be involved in the toxic effect. Current investigations are examining the role of caspase-3 in cadmium-induced apoptosis. Funding by NIH grant #P20RR016454.

Keywords: cadmium; rainbow trout; apoptosis.

## **Effects of DEM Resolution and Source on WEPP Hydrologic and Erosion Prediction: A Case Study of Two Forest Watersheds in Northern Idaho**

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The recent development of WEPP (v2005) has improved the original WEPP model's applicability to forest watershed hydrology and erosion modeling. To generate reliable topographic and hydrologic inputs for the WEPP model, carefully selecting Digital Elevation Models (DEMs) with appropriate resolution and accuracy is essential because topography is a major factor controlling water erosion. Recent developments in Light Detection and Ranging (LIDAR) technology provide a new option for generating fine and high-quality DEMs. This study applies WEPP (v2005) for hydrological and erosion simulation under a forest setting, and evaluates the effects of DEM resolution and accuracy on watershed hydrology and water erosion prediction at a watershed scale. Runoff and sediment yield in two small forest watersheds located in northern Idaho were collected and processed. A total of six DEMs from three sources (NED, SRTM, and LIDAR) at three resolutions (30-m, 10-m, and 4-m) were prepared and used to calculate topographic parameters as inputs to the WEPP model. WEPP hydrologic and erosion results from using the six DEMs were compared with the field-observed data. For both study watersheds, DEMs with different resolutions and sources generated varied topographic and hydrologic attributes, which in turn led to significantly different erosion predictions by WEPP.

**Keywords:** water erosion modeling; GIS; LIDAR.

## POSTER ABSTRACTS

### **Academic Service-Learning, Part 3: Building Bridges to Native American Students and Teachers**

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Our goal is to encourage and interest students and teachers in the Native American community in chemistry, and make resources available from the American Chemical Society (ACS) accessible. The umbrella concept for this program is called "A Periodic Table of the Moles", which we will briefly describe. Thanks to a Local Section Innovative Activity Grant to the Washington-Idaho Border Section, we sponsored dances at local student pow-wows for the youngest children, and made contact - by way of hands-on demonstrations - with the kids, parents and teachers. The main events were the Native American Awareness week pow-wow on the Lewis-Clark State University campus on March 10, the Pah-Loots-Pu pow-wow at Washington State University on April 16, and the Tutxinmepu pow-wow on the University of Idaho (UI) campus on October 29. We also held hands-on demonstrations during Environmental Education and Cultural Knowledge Day for Lapwai Elementary on the Nez Perce Reservation on May 25, and performed an Almost Mole day demo on October 22 as part of Native Youth day at UI. Finally, a dedication ceremony was held as "A Periodic Table of the Moles" was officially donated to the UI on Mole Day, October 23, 2005.

Keywords: chemistry; Native Americans; periodic table.

### **Element-ary Enthusiasm – University of Idaho Student Affiliates**

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True gusto for science starts easiest at a young age. The University of Idaho ACS Student Affiliate has been busy throughout the academic year encouraging chemistry enthusiasm in the youth of Moscow and surrounding community through a series of both fun hands-on experiments, like silly putty, and visually stimulating demonstrations, like electric pickle and gummy bear immolation. Our audience ranges from elementary children to college students, yet our goal is to entertain and educate all, making learning fun and promoting continued participation in chemistry. We work with local youth clubs, such as Adventure Club and 4-H, and area institutions such as the Palouse Discovery Science Center, elementary schools, and libraries, as well as presenting at local events such as the Latah County Fair, the Nez Perce Tribe's Tutxinmepu Powwow, and the Renaissance

Fair. We also invite these local groups to celebrate National Chemistry Week with us, presenting many demos including a special Mole Day Demo.

Keywords: chemistry; demonstrations; National Chemistry Week.

### **Preparation of Chalcopyrite Nanocrystallites Via Photochemical Decomposition**

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The synthesis and characterization of ultra fine CuInS<sub>2</sub> chalcopyrite semiconductor nanocrystallites will be presented. Ultra Violet irradiation was used to decompose a novel liquid single source precursor, yielding organic soluble ~2 nm sized nanoparticles with a relatively narrow size distribution. UV-visible absorption, NMR, MS, TEM, XRD, SEM-EDX, ICP and fluorescence characterization techniques were employed. The particles were found to have a CuInS<sub>2</sub> wurtzite crystal structure with a copper rich exterior surface, and show strong quantum confinement optical characteristics.

Keywords: Chalcopyrite; nanoparticles; solar cells.

### **Reaction Mechanisms and Competition in the Electrophilic C-H and C-C Bond Activation of CH<sub>4</sub> and C<sub>2</sub>H<sub>6</sub> by I<sup>+</sup>, Br<sup>+</sup>, Cl<sup>+</sup> and Cl<sub>2</sub><sup>+</sup>**

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Reaction mechanisms and rate constants are reported for the gas-phase electrophilic C-H bond activation of methane and ethane accomplished by selected halogen cations I<sup>+</sup>, Br<sup>+</sup>, Cl<sup>+</sup> and Cl<sub>2</sub><sup>+</sup>. In addition, ab initio calculations were carried out to further understand reaction mechanisms. Electrophilic attack into the C-H bond occurred in all cases along with several competing reaction mechanisms, electrophilic addition-elimination, hydride transfer, dissociative charge transfer and charge transfer. The reaction of I<sup>+</sup> with ethane shows electrophilic addition-elimination and hydride transfer ion products. No charge transfer reaction is expected because of the significant endothermicity of the charge transfer reaction. However, charge transfer becomes possible in the reactions of Br<sup>+</sup> and Cl<sup>+</sup> with ethane as the reactions become exothermic. This is evidenced by observation of increasing amounts of charge transfer ion products detected. The increase in exothermicity of reactions involving Br<sup>+</sup> and Cl<sup>+</sup> with methane and ethane yield a mixture of ion products formed by all the above listed mechanisms. Interestingly, singly charged diatomic halogens failed to react with methane, and only Cl<sub>2</sub><sup>+</sup> was found to react with ethane in any applicable amount. The two mechanisms proposed for this reaction are hydride transfer and charge transfer.

Keywords: gas-phase; activation; electrophilic.

## Impact of North American Insect Herbivores on the Invasive Plant *Lepidium draba*

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*Lepidium draba* is a perennial mustard indigenous to Eurasia that has become an invasive weed in the Western United States. Recent biogeographical comparisons found significant differences in the plant and insect community structures associated with the indigenous and introduced *L. draba* populations. U.S. populations had significantly higher abundance of polyphagous insects but were marked by lower species diversity and richness and only one *Lepidium specialist*, *Ceutorhynchus americanus*. Due to the invasive nature of this plant, we predicted that polyphagous insects in the U.S. do not impact the growth of *L. draba*, even at the high densities observed in the field. We tested this hypothesis under controlled conditions with three common insects species collected from U.S. *L. draba* populations: *Lygus elisus*, *Plutella xylostella*, and *Phyllotreta cruciferae*. We also quantified the impact of the specialist stem-mining weevil *C. americanus*. Plants were tested with each insect species at several densities both singly and in combination with the specialist. We found that plant vigor and biomass were only impacted at the highest density treatments in single insect experiments. The combined impact of two species was similar to single species at high density. Combined herbivore impacts were additive and there were no significant species interactions.

Keywords: *Lepidium draba*; insect herbivory; plant invasion.

## Competitive Foraging Interactions Between Two Invasive Intertidal Crab Species: *Hemigrapsus sanguineus* and *Carcinus maenas*

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Introduced predators can affect ecosystems via predation, hybridization, and/or competition (both interference and exploitative) with resident species. Competition may result in prey switching and/or reduced feeding rates. Two crabs of the eastern seaboard of North America, *Carcinus maenas* and the recently introduced *Hemigrapsus sanguineus*, have overlapping distributions. It is unknown whether competition alters the diet or foraging strategies of either species. In a series of field and laboratory measurements, I examined diet and prey preferences of both species at Appledore Island, Maine. I also conducted field caging experiments to determine whether crab foraging is altered when the two species co-occur. Results indicate that *C. maenas* altered its diet in the presence of *H. sanguineus*, reducing food consumption by 50% ( $p < .0001$ ) and switched from its preferred prey items, blue mussels ( $p = .0177$ ) and gammaridean amphipods ( $p = .0518$ ), to one of its least preferred items, red algae. *H. sanguineus* was unaffected by *C. maenas* in terms of diet. ( $p = .5308$ ) or amount consumed ( $p = .9177$ ). The change in foraging by *C. maenas* in the presence of

the new competitor could have contributed to the previously observed decline in *C. maenas*. Additionally, these foraging changes could have cascading effects on prey species resulting in widespread community effects.

Keywords: invasive species; crabs; competition.

### **No Evidence For an 'Evolution of Increased Competitive Ability' for *Lepidium draba***

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The evolution of increased competitive ability (EICA) hypothesis states that reduced herbivory in the introduced range causes a shift in resource allocation from herbivore defense to growth. Therefore, if genotypes of a plant species from its native and introduced ranges are grown under common standardized conditions, introduced genotypes are expected to grow more vigorously than conspecific native genotypes. Furthermore, the EICA hypothesis assumes that specialized herbivores will perform better on introduced genotypes compared to native genotypes, because they are less well defended. We tested predictions of the EICA hypothesis with the invasive *Lepidium draba* by 1) comparing growth of *L. draba* genotypes from its native European and introduced western U.S. ranges under common conditions in a greenhouse, and 2) conducting a feeding bioassay with the specialized herbivore, *Psylliodes wrasei*. Contrary to predictions, all individual plant traits measured in the greenhouse experiment were greater for the native, rather than introduced *L. draba* genotypes. In addition, we found no significant difference in the proportion of leaf area consumed by the specialist herbivore between native and introduced genotypes. Our data suggest that the EICA hypothesis is not suitable to explain the invasion success of *L. draba* in the U.S. Instead, we propose that the reduced shoot biomass of introduced genotypes may be due to selection for increased defense against generalist herbivores in the introduced range.

Keywords: *Lepidium draba*; *Psylliodes wrasei*; invasive species.

### **The Attraction of Invertebrates to Bioluminescent *Mycena* Fungi in the Atherton Tablelands, Queensland, Australia**

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Bioluminescence is the emission of light from living organisms either voluntarily (to attract other organisms or to communicate) or involuntarily as a chemical byproduct. This phenomenon is mostly utilized by marine life, but there are some terrestrial organisms known to luminate including several species of fungi. Very little is known about bioluminescent fungi. One idea as to why they

luminate is to attract invertebrates to aid in spore dispersal. The attraction of invertebrates to bioluminescent *Mycena* species was studied at the Centre for Rainforest Studies (CRS) in the Atherton Tablelands, Queensland, Australia. Invertebrate traps were set up at 15 fungi sites and 15 control (non-fungal) sites nightly, for three nights. Upon collection of the traps, invertebrates were collected and identified to the Order level. A significantly greater number of insect Orders was found in the fungal traps (mean 14) than the control (mean 6). Several of the arthropods found at the fungal sites are known to be fungivores including those found in arachnida. These results show a definite attraction of arthropods toward bioluminescent *Mycena* species. Further research in this area could tell us if the arthropods are assisting in spore dispersal.

Keywords: bioluminescence; fungus; spore dispersal.

### **Feeding Rates of Black Damsel Fish (*Neoglyphidodon melas*) in the Inner and Outer Reef Flat Zones of Heron Island, Australia**

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Feeding and hiding rates of black damselfish (*Neoglyphidodon melas*) were studied in two habitat zones (outer living coral zone and inner sandy zone) on the Heron Island reef flat, Australia. The number of bites and number of times a fish hid over 5-min. intervals were recorded for 150 damselfish. The damselfish occupying the outer living coral zone took significantly more bites ( $=41.2$ ) than those in the inner sandy zone ( $=22.96$ ). Fish in the inner sandy zone hid ( $=5.16$ ) significantly more often than fish in the outer living coral zone ( $=2.96$ ). Our results indicate that damselfish in the outer living zone spend more time feeding and less time hiding than fish in the inner sandy zone; thus, the outer living coral zone may be the preferred habitat area. The homogenous outer living coral zone may provide greater protection from predators than the inner sandy zone. Previous studies have shown that in less complex habitats (i.e. inner sandy zone) fish are more prone to attack. Secondly, a symbiotic relationship exists between surgeonfish, which are rare in the inner sandy zone, and damselfish in which the surgeonfish is the main protector of the damselfish algal mats allowing damselfish to spend more time feeding.

Keywords: feeding rate; damselfish; coral reef.

### **The Effect of Damselfish (Pomacentridae) on the Feeding Success of Parrotfish (Scaridae) in a Coral Reef Community**

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Territoriality is a form of competition among herbivorous fishes on coral reef systems. We investigated the effect of damselfish (Pomacentridae) territoriality on parrotfish (Scaridae) herbivory over a three day period. One hundred par-

rotfish were observed in the reef flat surrounding Heron Island, Great Barrier Reef, Australia. The number of bites each parrotfish took on a coral head was recorded. At each coral head we also noted the presence of damselfish. If the damselfish deterred parrotfish feeding, the damselfish was identified to species. In the presence of damselfish, parrotfish took significantly fewer bites on a coral head than when damselfish were absent. The mean number of bites taken by parrotfish with damselfish present was 2.75, while the mean number of bites taken with damselfish absent was 11.35. Our results indicate that the whitetail damsel (*Pomacentrus chrysurus*) and the black damsel (*Neoglyphidodon melas*) are the most common damselfish (51% and 38% respectively) to deter parrotfish feeding. The whitetail damsel is an herbivore and protects its food source from interspecific competitors, like parrotfish. However, black damsels are omnivorous, which may explain why they are less agonistic toward the herbivorous parrotfish. This study gives insight to better understand the metapopulation of a coral reef.

Keywords: Damselfish; Parrotfish; territoriality.

### **Comparison of Fish Community Composition between Caespitose and Massive Coral Morphotypes on the Great Barrier Reef, Heron Island, Australia**

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Heterogeneous habitats are known to support a greater number and different species composition than homogeneous habitats. Coral reefs are an ideal ecosystem to test this paradigm because they contain a variety of coral morphotypes, ranging from simple structured massives to structurally complex caespitose. We examined the difference in total fish abundance, species richness, and community structure between caespitose and massive coral morphotypes in the living coral zone of the Heron Island Reef flat, Australia. A visual census was conducted for 22 caespitose and 22 massive corals over a 4 day period. We observed 607 fishes representing 28 species. On average, caespitose corals supported a significantly greater number of fishes (20.1) than massive corals (7.5). Fish species composition was significantly different between the two coral morphotypes. The yellow-damselfish was the most common species among caespitose coral(32%), and ornate prawn gobies among the massive(29%). After standardizing for sample size, both morphotypes supported an equal number of species. The difference in behaviors, territoriality and foraging, of the diverse species is attributed to the difference in community composition. The greater complexity of caespitose coral provides more protection, food resources and a variety of microhabitats, niches and thus supports more total fish.

Keywords: fish; composition; coral.

## Distribution of Goby Fish Burrows on Sandy Reef Flats of Heron Island, Australia

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Gobiidae, the largest marine fish family, is found in nearly all marine habitats. Determining the mechanisms that regulate their populations is vital to understanding their basic ecology. In our study, we examined the distribution of burrows of four goby species within the sandy reef flat around Heron Island, Great Barrier Reef, Australia. We sampled six plots, each about 5 x 5 meters. While snorkeling above them, we flagged all of the occupied burrows within a plot before beginning measurements. The Clark Evans nearest neighbor method was used to determine burrow distribution. Our results indicate that the goby burrows are uniformly distributed, suggesting that these species are territorial. Our findings are supported by past studies which have found other goby species to be territorial. Possible reasons for territoriality include a lower risk of predation, limited food resources, or a higher probability of mating success. Many gobies have a mutualistic relationship with a shrimp and therefore another factor that may control the spatial distribution of goby burrows is the habitat preference of that shrimp. Our conclusions suggest a need for further studies to investigate issues regulating distribution of gobies as well as behavioral studies on territoriality.

Keywords: Gobiidae; spatial distribution; territoriality.

## Cadmium Induces Apoptosis in Human Osteosarcoma Cells

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The heavy metal cadmium is a known environmental and occupational toxin. Human exposure to cadmium has been associated with the development of bone diseases such as osteoporosis and osteomalacia. The mechanisms by which cadmium exerts a direct effect on bone remain unclear. Since bone cells routinely undergo apoptosis to balance bone formation and resorption, we hypothesize that cadmium disrupts the normal balance by inducing apoptosis. To test this hypothesis, the human osteoblast-like cell line Saos-2 was treated with 10 to 200  $\mu\text{M}$  CdCl<sub>2</sub> for 3, 6, 12, 24, or 48 hours. Cells were evaluated for apoptosis using annexin V as a marker for externalization of cell membrane phosphatidylserine. Hoechst staining and a DNA fragmentation assay were used to show nuclear changes associated with apoptosis. All assays indicated a significant increase in apoptosis with cadmium exposure. Cadmium induced apoptosis was also accompanied by an increase in caspase-3 activity (% caspase-3 activity in control = 0%  $\pm$  21.5; 100  $\mu\text{M}$  CdCl<sub>2</sub> 6 hour = 45.5%  $\pm$  12.4). These results suggest cadmium may be linked to bone disease by inducing apoptosis in osteoblasts. Future studies will focus on specific cadmium-induced cellular mediators of apoptosis. Funded by NIH grant P20RR016454 and Sigma Xi Research Society.

Keywords: Cadmium; apoptosis; osteoblast.

## Innate Immunity of the Nematode *C. elegans*

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All organisms face constant exposure to pathogens which they must defend themselves against. As a result, an innate immune system evolved very early and is conserved throughout phyla. The innate immune system can be very complex and difficult to study in large organisms, therefore an invertebrate model was chosen. *C. elegans* was chosen as the model because it is easy to grow and maintain, has a short generation time, reproduces hermaphroditically, and is transparent for easy microscopy. The worms were infected with a newly isolated species, *Pseudomonas filiscindens* strain ISU3, over a 16 hour period and were stained with Evans Blue to detect damaged cells. It was found that increased concentrations of lipoic acid, an antioxidant, increased necrosis of cells in the worm. This indicates that reactive oxygen species may play an important part in the innate immunity of *C. elegans*. This gives us more insight into the defenses of *C. elegans*, and may lead to more insight on the innate immunity of more complex organisms.

Keywords: *C. elegans*; innate immunity; free radicals.

## *Paramyotonia congenita*: Temperature Effects on Fast Inactivation of Voltage Gated Na<sup>+</sup> Channels

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*Paramyotonia congenita* (PC) is a genetic disorder which causes muscle weakness and is exacerbated by cold temperatures. Mutations in skeletal muscle tissue associated with the disorder affect the voltage-gated sodium (Na<sup>+</sup>) channels. We studied a point mutation in the sodium channel DIV SIV/SV linker which replaced a phenylalanine with a serine in the 1473 position. RNA was injected into *Xenopus laevis* oocytes for this mutation (F1473S+B) and wild type (hNav1.4+B) channels. We used an on-cell macro patch technique to record channel function. The kinetics of entry into the inactivated state from both the open and closed state and the probability of entry into fast inactivation were studied. Recordings were made at temperatures ranging from 12-25 degrees Celsius. Comparing the mutated channels to wild type channels, the probability of entering fast inactivation decreased, and the rate of fast inactivation decreased as well.

Keywords: Na<sup>+</sup> channels; *Paramyotonia congenita*; temperature dependence.

## Identification of Cytosol Proteins as Targets in Anthracycline Cardiotoxicity

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Cardiotoxicity of daunorubicin limits its therapeutic use in treating cancer patients. Proteins that may mediate daunorubicin cardiac toxicity were identified in cytosol from left ventricle of four different groups of rats. Rats were treated either with saline, daunorubicin, ICRF-187 (a daunorubicin cardioprotectant), or daunorubicin plus ICRF-187. Two dimensional gel electrophoresis was performed on cytosols from each group at pH 5-8. Proteins that were down-regulated in the daunorubicin treated gel but returned to control density in the daun+ICRF treated gel were extracted using in-gel tryptic digestion methods and proteins identified by tandem mass spectroscopy. Proteins identified using LC/ESI/MS/M were albumen and dehydrogenase B; this work funded in part by NIH P20RR16454 and MSTMRI.

Keywords: cancer; anthracycline; cardio.

## Conjugating Magnetic Nanoparticles for Application in Health & Environmental Research

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The specific aims of our work were to (1) conjugate a Magnetic Nanoparticle (MNP) to an enzyme, and (2) conjugate a MNP to an anti-cancer agent (investigational new drug, IND). First, a primary analysis of the activation and conjugation of the MNP was performed with the protein Trypsin. The MNP and Trypsin were activated successfully. Conjugation was studied by ATR-FTIR, and activity was evidenced by Fluorimetry. Our primary results showed that while the Trypsin's activity was attenuated upon attachment to the MNP, it still retained significant activity. A reactive handle for conjugating the IND to the MNP was needed and synthetic modification of the IND was studied. A Chloro-Ester-Isoxazole was created and will be combined with an amine by double activation. This combination should produce a product that will be conjugated to the MNP. Progress towards our specific aims will be described. The project was funded by NIH P20RR016454.

Keywords: magnetic nanoparticles; conjugating magnetic nanoparticles; Trypsin and IND.

## Reactivity of Transition Metal Cations with CO and CO<sub>2</sub>

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An understanding of transition metal-CO complexation has deep implications in theories explaining the evolution of life. Additionally, understanding interactions involving these same metals and CO<sub>2</sub> have provided a basis for catalysts useful in the sequestration of CO<sub>2</sub>.

Through the use of a flowing afterglow instrument, the gas phase reactions of selected first period transition metal ions (Ti<sup>+</sup>, V<sup>+</sup>, Fe<sup>+</sup>, Co<sup>+</sup>, Ni<sup>+</sup>, Cu<sup>+</sup>, Zn<sup>+</sup>) and both CO and CO<sub>2</sub> gases were studied. High level ab initio calculations were also used to produce potential energy surface diagrams for selected reactions.

During the course of this study, the formation of double charged ions was also unexpectedly observed. While high energy conditions and expensive instrumentation are usually required for such ion formation, we observed these ions by simply decreasing the argon flow at the sputter source. Current studies involve obtaining a better understanding of this process, and studying reactions of these ion species.

Keywords: gas-phase; transition-metal; reactivity.

## Photometric Detection of the Transit of “Hot Jupiter” HD 189733b

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Short period giant planets are ideal for small telescope studies because they can occult parent stars for several hours with approximately a 1% decrease in the star's light. We completed visual photometry of HD 189733 over 5 nights during January 2006 using the 0.35-m ART at Albertson College. The transit of HD189733b was successfully captured using an SBIG ST-9E CCD with a series of 154 exposures lasting 20 seconds each. Results show a magnitude change of 0.5 in V and an orbital period of  $2.28 \pm 0.03$  hours.

Keywords: photometry; exoplanet; transit.

## Photometric Observations of RR-Lyrae Stars RR-Gem and RR-Leo

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Low-metal, radially-oscillating (RR-Lyrae) stars play a significant role in determining the distances to galactic objects. In an effort to better understand these stars, photometric observations in R and V of RR Gem and RR Leo were collected over several nights during February 2006 using the 0.35-m ART at Al-

bertson College. RR Gem displays a magnitude variation of  $11.55-10.73 \pm 0.01$  over a period of  $0.33 \pm 0.1d$ . RR Leo displays a magnitude variation of  $11.29-9.91 \pm 0.01$  over a period of  $0.43 \pm 0.1d$ . Preliminary distance determinations using the distance modulus method, with  $M_V = 0.7$  for both RR Gem and RR Leo, are  $1.3 \pm 0.1$  kpc and  $.95 \pm 0.1$  kpc, respectively.

Keywords: photometry; RR-Lyrae; period.

### **The 2005 Earthquake Swarm, Cascade, Idaho**

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Beginning September, 2005, thousands of small earthquakes have been occurring in Valley County, Idaho. These events, four with magnitudes as high as 4, are centered about 16 kilometers south of Cascade, Idaho in the vicinity of Clear Creek. Although little damage has been reported, the events have been widely felt, and have caused considerable concern in the local population. The events appear to be very shallow, about 4 kilometers deep. Fault plane solutions for the larger events in the swarm indicate a northwest-oriented direction of compression and a significant component of left-lateral strike-slip. Most swarms of this nature in the western states slowly dissipate over a number of months; some however develop into stronger swarms capable of significant building damage. The Idaho Geological Survey and the Boise Regional Network, with support from the Idaho Bureau of Homeland Security, is continuing to monitor the swarm seismicity.

Keywords: earthquake; Idaho; swarm.

### **A Novel Method For Continuous Crop Monitoring and Yield Estimation In Vineyards**

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<sup>2</sup>Washington State University Center for Precision Agricultural Systems.

<sup>3</sup>Washington State University Extension Viticulture.

We have developed a system for continuously monitoring crop development and predicting yield in vineyards as an alternative to the current industry methods that rely on a few, costly hand sampling events during the season. Our method involves direct, continuous measurement of tension in the trellis wire by load cells. The record of increasing tension during the season can be used to follow crop development and to make estimates of final yield. Two load cell systems are being tested: one where the load cell senses tension along the entire row ("Open" system), and a second where the load cell is installed in a restricted length of trellis wire between two posts that are fixed by a steel brace dubbed the

“Bridge” system. During 2005 measurements of wire tension were repeated in a 0.8-acre, drip irrigated Concord research vineyard. Continuous estimates of yield were made with an empirical model that used the tension measurements and final yield from 2004. Also in 2005 was the first full season of tension measurements using paired “Bridge” and “Open” systems in 10 commercial juice grape vineyards and in a Merlot research vineyard with a single cordon wire and two foliage wires. (<http://www.fruit.wsu.edu/Grapeweb/cropload.htm>)

Keywords: yield estimation; grapes; plant growth.

## **Environment-based Education for Greater Yellowstone Schools**

**Donny Roush**

Idaho Environmental Education Association, 2211 S. 2nd Ave., Pocatello, ID 83201.

This coming school year, 12 schools throughout the Greater Yellowstone Ecosystem will begin demonstrating an environment-based method of instruction designed to meet educational standards while strengthening community connections. Four schools each in Idaho, Montana, and Wyoming will employ The EIC Model--using their local environments as integrating contexts to learning. The EIC Model ties together six educational best practices: integration across disciplines, community-based investigations, team-teaching, learner-centered approaches, combining independent and cooperative learning activities, and the study of natural and social systems. The EIC Model's research-based record of success includes improvements on standardized tests for 92% of students in a nationwide study cohort. Evaluation plans for the Yellowstone regional cohort call for tracking of standardized test scores, authentic assessments of student achievement, and survey-based measures of teacher aptitude with this school reform model. The dozen Yellowstone schools join five additional Idaho schools that have been using EIC since 2003. Evaluation data from the existing Idaho schools suggest that EIC has been effective here as well.

Keywords: environmental-based education; school reform; educational standards/

## **Demographic Monitoring of Spalding's catchfly (*Silene spaldingii* Wats.) in Canyon Grasslands of Idaho**

**Janice Hill<sup>1</sup> and Karen Gray<sup>2</sup>**

<sup>1</sup>2990 State Hwy 3, Deary, ID 83823.

<sup>2</sup>Idaho Fish & Game Conservation Data Center.

Spalding's catchfly, a Threatened plant endemic to bunchgrass grasslands, sagebrush-steppe, and open pine communities of the inland Pacific Northwest, is an herbaceous perennial forb that can survive belowground from one to three years in prolonged dormancy. Two demographic studies tracked mapped plants for four years in the Snake and Salmon river drainages to determine long-term viability of this species in Canyon Grasslands. Plants emerged aboveground in May as either: 1) stemmed plants which became reproductive or remained vegetative at flowering or 2) rosette plants which remained vegetative and did

not bolt into stemmed plants during the growing season. Age of plants did not correlate with growth form. Rosette plants can be seedlings, but most rosettes are produced by mature plants. Reproductive plants often revert to vegetative stemmed or rosette plants in subsequent years. Considerable loss of plants occurred during the growing season, with over half of the plants present early in the season gone or dead by flowering. Significant inaccuracies in population size and other demographic parameters can result from monitoring only at flowering, and it is critical that demographic studies for Spalding's catchfly in Canyon Grasslands include an early monitoring period soon after emergence when all plants are detectable.

Keywords: *Silene spaldingii*; demography; canyon grasslands.

### **Countryside Biogeography and the Matrix: Is Conservation-tillage Conservation Biology?**

**Timothy Hatten<sup>1</sup>, Nilsa A. Bosque-Pérez<sup>1</sup>, Sarah Gebbie<sup>2</sup>,  
and Sanford D. Eigenbrode<sup>1</sup>**

<sup>1</sup>Department of Plant, Soil and Entomological Sciences, University of Idaho, Moscow, ID. 83844-2339.

<sup>2</sup>Lake George Regional Planning Board.

It is well established that the invertebrate community in cropland under conservation-tillage (consT) is often enriched relative to the community under conventional-tillage (CT) systems. The question posed in this research is whether consT contributes to the maintenance of regional biodiversity and to the conservation of prairie-inhabiting species in agriculturally-dominated landscapes that contain prairie remnants. During 2002, we sampled the ground-dwelling beetle fauna of remnant Palouse prairie and surrounding cropland (under CT and consT) in the Palouse region of northwestern Idaho and southeastern Washington. Biological diversity of representative taxa, Curculionidae (weevils), Tenebrionidae (darkling beetles) and Scarabaeidae (scarab beetles), is significantly higher in the prairie than in agricultural fields, while diversity of these groups in fields under consT is intermediate to that found in the prairie and fields under CT. Faunal similarity (Bray-Curtis Index) is greater between consT and prairie than between CT and prairie. Together, these results indicate that ConsT potentially improves conservation and the preservation of prairie species in agriculturally-dominated landscapes.

Keywords: conservation tillage; matrix; Palouse.

### **Comparison of Pyrrolizidine Alkaloid Induction in European and North American Populations of Houndstongue**

**Sanford Eigenbrode, Jennifer Andreas, Hongjian Ding, Russell Biggam,  
and Mark Schwarzländer**

University of Idaho, Department of Plant, Soil and Entomological Sciences, Moscow, ID. 83844-2339.

The 'Evolution of increased competitive ability'<sup>1</sup> (EICA) hypothesis predicts that invasive plant populations in the introduced range will have lower concentra-

tions of defensive secondary chemicals than populations of the same species in the native range. The EICA hypothesis as originally formulated did not consider the implications of the widespread phenomenon of induction of plant defenses in response to herbivory. A modification of EICA incorporating inducibility predicts that induced levels of chemical defenses will not be lower, but the relative induction of defense after herbivory will be more variable in the introduced range. This should occur if reduced herbivory reduces exposure of the induced levels of chemical defense to natural selection in the introduced range, whereas in the native range stabilizing selection maintains induced chemical defenses closer to optimal levels. We compared constitutive and induced concentrations of pyrrolizidine alkaloids (PAs) from native (European) and introduced (western North America) populations of *Cynoglossum officinale*. The constitutive and induced concentrations of PAs did not differ between continents, but the variability of the induced concentrations and the induction ratio (induced concentration/constitutive concentration) was significantly greater for plants from the introduced range. This result is consistent with the predicted pattern of a modification of EICA that considers inducible defenses.

Keywords: evolution of increased competitive ability hypothesis, *Cynoglossum officinale*, induction.

### **Computer Assisted Evaluation of Activation Medium pH Effect on Motility of White Sturgeon (*Acipenser transmontanus*) Sperm Using Freely Available Software**

**Jonas Wilson-Leedy<sup>1</sup>, M.D. Zuccarelli<sup>2</sup>, J.G. Cloud<sup>2</sup>, and R.L. Ingermann<sup>2</sup>**

<sup>1</sup>University of Idaho, 307 Sweet Ave Apt 5, Moscow, ID 83843.

<sup>2</sup>University of Idaho.

The motility of sperm from white sturgeon (*Acipenser transmontanus*) has been assessed under a range of activating pH values using novel computer assisted analysis based upon the free software, ImageJ. Analysis consisted of tracking sperm for one second to determine sperm velocity and path characteristics. These data were utilized to ascertain a treatment's effect on average velocity and path character for motile sperm (degree of curvature and deviation from an average path) and on percent of sperm initiating motility upon activation. Percent motility and velocity of sperm were significantly reduced when sperm were activated in pH 7 Tris buffered solution as compared to deionized water, tap water and the same solution buffered from pH 7.5 to 9. Sperm activated in pH 7 or 8 Tris solution with 20mM NaCl or choline Cl had lower motility than in the same solution without salt. Sperm activated in the salt solutions at pH 7 had greater path curvature and greater deviation from the average path than Tris solution without salt at pH 8, tap water and deionized water. ImageJ provides an objective means of assessing motility, velocity and path characteristics of fish sperm in relation to treatments.

Keywords: computer-assisted sperm analysis; pH; sturgeon.

## Prescribed Sheep Grazing to Control Cheatgrass and Medusahead and Facilitate Restoration of Annual Grasslands

Lovina Roselle and Karen Launchbaugh

Department of Rangeland Ecology & Management, College of Natural Resources, University of Idaho, P.O. Box 44135, Moscow, ID 83844.

Many areas in the North American Intermountain West region have been converted to a rangelands dominated by exotic annual grasses including cheatgrass (*Bromus tectorum*) and medusahead rye (*Taeniatherum caput-medusae*). Several research and demonstration projects have revealed that targeted grazing by cattle and sheep can be applied to reduce the biomass and reproductive output of these grasses. We conducted research in 2004 and 2005 in the grassland steppe scablands of eastern Washington to examine the potential value of spring grazing by sheep to facilitate revegetation efforts in annual grasslands. Five research paddocks were constructed in both cheatgrass and medusahead sites to examine: 1) trampling by sheep to plant perennial grass seeds, and 2) spring grazing on the persistence of cheatgrass, medusahead, and perennial grasses. Paddocks were subdivided into four lanes each in which the following treatments were randomly applied: 1) fall trampling by sheep, 2) spring sheep grazing, 3) fall trampling with spring grazing, and 4) control. Initial results reveal that spring grazing significantly reduced the biomass, density, height, and seedhead production of annual grasses compared to ungrazed treatments.

Keywords: cheatgrass; medusahead; restoration.

## The Influence of Shrub and Tree Groundcover on the Nesting Success of *Chelonia mydas*, Heron Island, Great Barrier Reef, Australia

Jessica Weeks<sup>1</sup>, Mike Wells<sup>2</sup>, Lorissa Gibson<sup>2</sup>,  
and Samantha Fundingsland<sup>2</sup>

<sup>1</sup>Albertson College of Idaho, 2112 Cleveland Blvd, Caldwell Idaho, 83605.

<sup>2</sup>Albertson College of Idaho.

Heron Island, located on the southern half of the Great Barrier Reef, is a primary nesting site for *Chelonia Mydas* (green sea turtles). The nesting period on the island occurs between November and March. Selection of a nesting site is dependent on several environmental factors, including but not limited to; beach slope, sand type, artificial light and vegetation. This project focuses on the effects of trees and shrubs, in the area directly surrounding the nesting site, on the success of a nesting site. The construction of body pits was observed, during the hours surrounding the nightly high tide, and each was recorded as successful or unsuccessful. There was not a significant correlation found between vegetation density and successful nesting at our site; however, it is impossible at this point to determine whether our results were a result of factors occurring only at Heron Island or if vegetation truly has not effect here.

Keywords: turtle; *Chelonia mydas*; Heron Island.

## **Influence of Heavy Metals on Motility Characteristics of Sperm from Endangered Kootenai River White Sturgeon (*Acipenser transmontanus*)**

**M.D. Zuccarelli<sup>1</sup>, J. Wilson-Leedy<sup>2</sup>, J.G. Cloud<sup>2</sup>, R.L. Ingermann<sup>2</sup>**

<sup>1</sup>Department of Biological Sciences, Center For Reproductive Biology, University of Idaho, Moscow, ID 83844-3051.

<sup>2</sup>Department of Biological Sciences, University of Idaho.

Sperm of freshwater fish initiate motility upon dilution in hypotonic media (i.e. river/lake water). The percentage of sperm that initiate motility, their swimming characteristics and potentially sperm fertilizing ability, is altered by the composition of the activation media. The Kootenai River white sturgeon (*Acipenser transmontanus*) is an endangered population in the Columbia Basin in general decline as result of low natural recruitment. Heavy metal concentrations in the region, a result of mining activity in addition to natural leaching, are particularly high. It is not known whether dissolved metals interfere with sturgeon reproduction. This study was designed to test whether heavy metals (aluminum, cadmium, copper, iron, mercury and zinc) alter motility characteristics (percent motility, velocity, and linearity of motion) of white sturgeon sperm upon activation. Cadmium, iron, and mercury were found to significantly alter percent sperm motility at concentrations as low as 0.31 mM. Similarly, cadmium and mercury decreased sperm velocity at concentrations of 0.62 mM and swimming linearity at 1.25 mM. The metals aluminum, copper, and zinc failed to alter sperm motility characteristics at concentrations below 2.5 mM; a concentration beyond reported environmental levels of exposure. Subsequently, while environmentally relevant concentrations of aluminum, copper, and zinc posed little threat to sperm motility, cadmium, iron, and mercury significantly altered sperm motility characteristics and could conceivably inhibit sperm fertilizing ability at levels within environmental concentrations.

Keywords: white sturgeon; sperm; heavy metal.

## **Movement patterns of redband trout (*Oncorhynchus mykiss gairdneri*) in a high desert stream**

**Lucas Stringfield<sup>1</sup> and Chris A. Walser<sup>2</sup>**

<sup>1</sup>Albertson College of Idaho, 2016 S 10th Avenue, Caldwell, ID 83605.

<sup>2</sup>Albertson College of Idaho.

The Columbia River redband trout (*Oncorhynchus mykiss gairdneri*) is native to inland drainages of the Pacific Northwest. Resident forms of redband trout occupy isolated headwater streams and are considered a species of special concern in Idaho and Oregon. An understanding of redband movement patterns is needed to develop a successful conservation plan for this species. We used radio transmitters (Advanced Telemetry Systems) to study the movement of 15 adult redband trout (>150 g) in Jordan Creek (Owyhee River drainage), a high desert mountain stream near Silver City, Idaho. In September 2005, radio transmitters were surgically implanted (via a modification of the shielded needle technique) and fish were tracked weekly for 45 days. Our radio tag implantation technique proved effective---all tagged fish survived and remained free of infection over the course of the study period. Fish moved an average of 0.41km

over the 45-day study period, often moving through very shallow water (< 50 cm). Some individuals remained in the same pool throughout the study period while others moved as far as 0.99 km. Movement patterns of fish appeared to be associated with the search for suitable over-wintering habitat (deep pools near beaver dams).

Keywords: redband trout; radio telemetry; fish movement.

### **Initiation and Evolution of Surface Crack Networks in Sand-Bentonite Mixtures Observed with X-Ray Computed Tomography**

**Thomas Gebrenegus and Markus Tuller**

Soil & Land Resources Division, Department of Plants, Soil and Entomological Sciences, University of Idaho, Ag Sci. 255, Moscow, ID, 83844-2339.

Clayey soils are widely used as construction materials in civil and geotechnical engineering applications. Especially swelling clays receive increasing attention as hydraulic barriers for isolation of hazardous waste. However, swell-shrink dynamics of clay in response to changes in water content can induce surface desiccation cracks, which act as preferential transmission zones for pollutants and potentially lead to groundwater contamination. Initiation of crack formation and the size and complexity of desiccation crack networks are a function of clay mineralogy and content, solute type and concentration, and drying rate. To investigate effects of these physico-chemical factors on crack formation we conducted dehydration experiments with bentonite-sand mixtures under well controlled boundary conditions. Infrared heater panels in conjunction with thermocouples were employed to precisely control and monitor the sample surface temperature. To document the development and evolution of shrinkage crack networks in course of the dehydration process, the samples were scanned in fixed time intervals with a 225 kV micro-focus industrial X-Ray Computed Tomography system. Mathematical morphology operations were used to analyze reconstructed X-Ray CT images and to quantify morphological features of the crack networks. Effects of solution chemistry, clay content, and drying rate on formation and evolution of crack networks are discussed.

Keywords: Bentonite-sand mixtures; crack networks; X-Ray computed tomography.

### **Understanding the Movement of Nitrates in Ground Water of the Eastern Idaho Snake River Plain Using Maps Derived from Driller's Logs**

**William H. Hokanson<sup>1</sup> and Mark D. Lovell<sup>2</sup>**

<sup>1</sup>BYU – Idaho, 437 W 2nd S, Rexburg, Idaho 83440. <sup>2</sup>BYU – Idaho.

Water samples collected near Ashton, Idaho contain concentrations of nitrates that exceed EPA MCL guidelines. The distribution of wells yielding samples with high concentrations of nitrate initially appears to be random. To understand the stratigraphy of the subsurface, driller's logs, obtained via the Internet from the Idaho Department of Water Resources were examined. A table

was created from the elevation of the lithologic breaks using sea level as the datum. Elevation boundaries were defined on the basis of rock type, color, and fracture characteristics provided in the driller's logs. Generalized subsurface maps were created for the different rock units. Major rock units identified were unconsolidated alluvium, basalt flows, and felsic volcanics. The maps will aid in understanding migration pathways of nitrates in the subsurface and help explain the apparent pattern of nitrate contamination in wells.

Keywords: nitrates; Ashton, Idaho; Eastern Snake River Plain.

### **Elucidating the Role of Calpain I Cleavage Of $\alpha$ -Synuclein In Parkinson's Disease and Dementia with Lewy Bodies**

**Kwang-Ho Ha<sup>1</sup>, Peter Mouser<sup>2</sup>, and Troy T. Rohn<sup>2</sup>**

<sup>1</sup>Biology Department, Brigham Young University – Idaho, 525 Center St. Rexburg, ID 83460.

<sup>2</sup>Boise State University.

Parkinson's disease (PD) and dementia with lewy bodies (DLB) are both neurodegenerative diseases characterized by motor dysfunction and dementia with loss of cognitive skills, respectively. While distinct in their clinical presentation, both PD and DLB share a common pathological feature: the presence of neuronal inclusions termed Lewy bodies (LBs) consisting of a 140-amino acid protein,  $\alpha$ -synuclein ( $\alpha$ -syn). A key step in the development of LBs is the fibrillization of  $\alpha$ -syn following its abnormal turnover by, as yet unidentified, proteases. The present study is aimed to determine whether calpain I, a ubiquitously expressed protease, is able to cleave  $\alpha$ -syn *in vitro* and *in vivo*. Using Western blot analysis and immunohistochemistry, it was demonstrated that calpain I is able to cleave  $\alpha$ -syn. Based on our preliminary results, we provide evidence that calpain I may be a candidate protease involved in modifying  $\alpha$ -syn, leading to the formation of LBs *in vivo*. This work was funded by NIH-P20RR016454.

Keywords: Lewy bodies;  $\alpha$ -synuclein; Parkinson's disease.

### **Interdisciplinary Approaches to Conservation Practices in a Mixed-Land Use Watershed**

**Jan Boll<sup>1</sup>, J.D. Wulfhorst<sup>2</sup>, Erin Brooks<sup>1</sup>, Larry Van Tassel<sup>2</sup>, Bob Mahler<sup>3</sup>, and Nagasrinivasa Tosakana<sup>4</sup>**

<sup>1</sup>Department of Biological and Agricultural Engineering, University of Idaho, Moscow, ID 83844.

<sup>2</sup>Department of Agricultural Economics and Rural Sociology, University of Idaho.

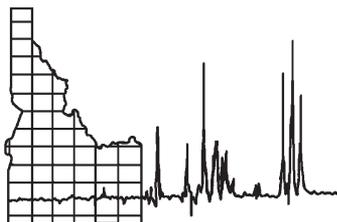
<sup>3</sup>Department of Plant, Soil and Entomological Sciences, University of Idaho.

<sup>4</sup>Environmental Science Program, University of Idaho.

Reports on effectiveness monitoring at the watershed scale across the United States contain a mix of successes and failures. The reason for the failure to observe changes at the watershed may include incorrect sampling frequency, lack of spatial resolution in monitoring, less than optimal selection of location for conservation practices, too few conservation practices, and interference of other activities in the watershed. This presentation provides a preliminary assessment of some of these reasons through an USDA-CSREES funded project as part of

the Conservation Effectiveness Assessment Program (CEAP) affecting Paradise Creek watershed located near Moscow, ID. Our project data sets include long-term monitoring at the watershed outlet, bi-weekly sampling “before” and “after” practice implementation at eight locations within the watershed, continuous monitoring in a nested watershed system, as well as detailed field-level data related to production and management in the watershed. Digital maps of topography, soils and land use exist including a 10-year history of land use change and conservation practices. In this presentation, we provide an overview of all activities in the project including: statistical evaluation of monitoring data, geo-spatial modeling, socio-economic data collection, integrated modeling of physical, economic and social information, and data management.

Keywords: effectiveness monitoring; conservation practices; watershed integration.



## 2005 Distinguished Science Communicator

REBECCA THORNE-FERREL

Rebecca Thorne-Ferrel was selected as the Distinguished Science Communicator Award for 2005. She currently is the Education Resources Coordinator for the Idaho Museum of Natural History in Pocatello, Idaho where she has spearheaded education programs for more than 20 years and touched the lives of more than 250,000 children.

Rebecca calls herself an “indigenous” person of the Pocatello valley. Her family moved there in 1955 and she has called Pocatello home every since. She graduated from ISU in 1972 with a B.A. in Elementary Education and spent much of the 70s teaching in the Pocatello area. Next, after spending a few years focusing on raising her family, Rebecca returned to ISU as the Museum’s Education Resource Coordinator in 1984. In 1986-87 she received a Kellogg Fellowship which allowed her the opportunity to increase her museum education knowledge at the Field Museum in Chicago, IL. In 2003 she completed her Masters of Education Instruction Technology at ISU and is currently working on her Ed.D. in Instructional Technology.



At the 2005 Idaho Association of Museums, Rebecca presented a talk entitled “Beyond Outreach: Sleepovers, Online Adventures, Birthday Parties and Events”. She also has made presentations at the Western Museums Association conferences on a number of occasions. She received a National Education Television Association Award in 1997 for her “Science Trek” program, as well as the Pacific Northwest Clean Water Association Public Education Award in 2002.

Rebecca has built the educational resource center at the Museum of more than 2,300 science-related games, books, puzzles and activity kits and made them available free of charge to teachers and parents throughout the state of Idaho. Her outreach programs have brought science to students who otherwise might be unable to visit the Museum. This includes her published and online materials that offer children insights into the world around them.

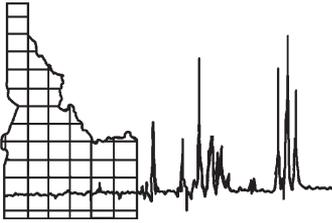
To quote part of one of her nomination letters “Rebecca established outreach scientific experiences for the smaller, rural communities in southeaster Idaho. She worked on every aspect of this project from building education displays and curriculum to arranging transportation or personal delivery of such items. Her enthusiasm was endless. She would, upon occasion, leave the museum at 4:00 a.m. to travel to a remote site in order that students could experience the amazement of science. She would stay all day working with the students and either spend the night in the community or drive home late at night.”

Another nomination letter stated “Over the years Rebecca has been very creative in her ways to delivery natural history topics using Museum objects and topics. Two efforts deserve special note. She single-handedly created, built and sustains the IMNH Education Resources Library. This collection of discover boxes, books, videos, tapes, maps, puzzles and other materials is loaned free to parents and teachers wanting materials to enrich their children’s lives. The other is her “Just for Kids” section on the IMNH website. She learned web page creation, animation and programming especially to expand this way to reach out to younger Idaho informal learners.

Rebecca also enjoys traveling. She has been to China, Egypt and Canada as well as various places about the U.S. Her journeys to China and Egypt included visits to museums.

Rebecca competed in high-power rifle shooting. In 1982 she was both Idaho and Utah High Lady. In seventy seconds, she fired ten rounds from her left-handed bolt-action rifle more accurately and faster than all of the men using semiautomatics! She also loves sewing, having made christening gowns, a wedding dress, baby bonnets, reproduction Victorian clothing and a pair of reproduction Medieval pants. She also loves to read and collecting books.

One treat she received in spring 2005 was when one of her former 3<sup>rd</sup> grade students came to the museum as a chaperon mother, reintroduced herself and shared fond memories of Rebecca being her teacher!

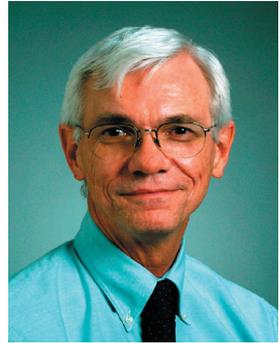


## 2005 Distinguished Scientist/Engineer

PROFESSOR MICHAEL B. LAKOWSKI

Professor Michael B. Laskowski received the 2005 Distinguished Scientist/Engineer Award. He is currently a Professor at the University of Idaho and his research focuses on the development of the nervous system, specifically the understanding of cues used by developing neurons in selecting their appropriate targets.

Mike grew up in Chicago. His mother loved nature and Mike says he drew his inspiration from her. In 1966, he received his B.S. in Biology from Loyola University in Chicago and his Ph.D. in 1971 from University of Oklahoma Medical School in Physiology. He did postdocs at Northwestern University in Evanston IL in electron microscopy of the neuromuscular junction and Vanderbilt University in neuro-muscular pharmacology. Mike was a visiting professor at Washington University School of Medicine from 1984-5 and 1997-98. He worked as an assistant professor at Vanderbilt University and St. Louis University. He has been a professor in the Department of Biological Sciences at the University of Idaho since 1988 to present and a professor at Washington State University since 1994 to present. Mike directed the WWAMI Medical Program at University of Idaho and Washington State University from 1988 to 2003.



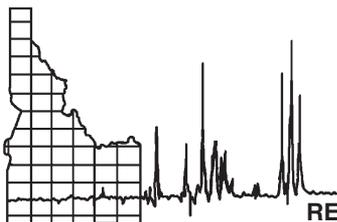
One of Mike's nominators said "What is especially noteworthy, however, is Mike's role in the development of health research across the state, first as Principle Investigator on the Biomedical Research Infrastructure Network (BRIN), which was a multi-million dollar grant to build a biomedical infrastructure in Idaho. The progress made with the BRIN was terrific, almost 400 faculty and students participated from throughout the state. For the next five years Mike will serve as director if the IDeA Network for Biomedical Research Excellence (INBRE). INBRE is a \$16.1 million grant from the National Institutes of Health (NIH) to create a statewide research and education network that will continue to advance efforts to grow a healthy bioscience industry in the state of Idaho. Mike has been a champion of health research across disciplines, and has worked tirelessly to include the Universities, Colleges and students from throughout the state of Idaho."

Mike's own research has been published in refereed journals, including articles in *Journal of Neurobiology*, *Muscle and Nerve*, *Journal of Neuroscience* and *Neuron*. He received the distinguished research award from the University of Idaho in 2003, the Margaret S. Anderson Award from the University of Wash-

ington School of Medicine in 2003 and the Vandal Pride Award in 2003. He also has received numerous other teaching awards from University of Washington School of Medicine and St. Louis University School of Medicine.

In addition, Mike serves as a reviewer for NSF grants, NIH special emphasis panels and Idaho State Board of Education grants. He reviews articles for *Developmental Dynamics*, *Journal of Neuroscience*, *Journal of Neurobiology* and *Experimental Neurology*.

Mike says he met his future wife at Loyola University. They have 4 children (two adopted) and 11 grandchildren. His hobbies are studying and learning, mainly in the fields of math and physics. He tries to take one course a semester in either math or physics. When Mike retires, he is thinking about going back to school to study astrophysics as a hobby.



## IAS Award Program

**NOMINATIONS NOW BEING ACCEPTED  
FOR THE AWARDS. NOMINATIONS  
RECEIVED AFTER FEBRUARY 28 EACH YEAR,  
MAY BE SAVED FOR THE FOLLOWING YEAR**

The Idaho Academy of Science seeks nominations for two prestigious annual awards:

### **DISTINGUISHED SCIENTIST/ENGINEER**

Individual with outstanding achievements in science or engineering.

### **DISTINGUISHED SCIENCE COMMUNICATOR**

Individual with outstanding achievements in communicating the meaning and values of science to students and/or the general public.

The awards will be presented at the Academy's next Annual Meeting and Symposium.

### **REQUIREMENTS AND ELIGIBILITY**

Nominees' work should be conducted in or related to the state of Idaho. That means the person may live and work in Idaho or the work that he/she has done is of specific value or interest to Idahoans. Nominees need not be members of the Idaho Academy of Science or even professional scientists so long as their accomplishments are clearly scientific or in the realm of science education. Generally, nominees must be living at the time of the nomination . . . only in truly exceptional cases would the Academy consider giving an award posthumously. Other than these conditions, any individual who has contributed substantially to science/engineering or to science communication is eligible for one of these awards.

Submit nominations (4 copies please) to the IAS Award Program Coordinator at:

Dr. Dwight Wray  
IAS Award Program Coordinator  
BYU-Idaho Dept. of Biology  
Rexburg, ID 83460-1100  
E-mail: [wrayd@byui.edu](mailto:wrayd@byui.edu)  
Phone: (208) 496-2004

### **NOMINATION PROCEDURES**

Nominations must be typed and submitted in quadruplicate (four copies). All should include the following information:

- Nominee's name, institutional or company affiliation\*, address, and phone number. [Optionally, the nominee's title and e-mail address may be included.]

- A summary of the accomplishments for which the person is to be recognized (about 250 words).
- A brief biographical sketch of the nominee, including educational and professional career information.
- The nominator's name, address, phone number, and (optionally) e-mail address.
- At least one seconding letter in support of the nomination, more are preferable.

But the core of the nomination is:

- A detailed description of what makes the nominee worthy of an Award.

In no more than three or four typed pages, the nominee's accomplishments should be described in broad terms, with a statement of why the work is considered outstanding. Just enough key details should be included to support the case being made. This supporting description will vary depending upon the Award and, to some extent, the nature of the nominee's accomplishments.

Nominations for Distinguished Scientist/Engineer should focus on the breakthrough qualities of his or her accomplishments. Typically, this would include a discussion of pioneering discoveries, seminal investigations, major innovations, and so on . . . always with a brief statement of why these are considered to be landmark achievements. Evidence of leadership - numerous citations of his or her publications, widespread follow-on work by others, service on technical committees and advisory groups, etc. - would do much to support the nominations. It is acceptable to include a full list of publications and patents in the nomination package, but a better approach would be to show only the most important papers and simply state the total number the nominee has to his or her credit.

Nominations for Distinguished Communicator could well cite innovation and inventiveness, but they are also likely to focus on effectiveness, impact, and influence. Outstanding achievers in education devise innovative classroom or field exercises and programs, create new and better ways to present scientific materials, find fresh ways to reach out to more students . . . they do whatever it takes to effectively convey the facts and concepts of science, and an appreciation for the scientific enterprise. Of course, providing "hard evidence" for the value of some of these accomplishments may be difficult. Sometimes the work may result in the publication of a manual, a conference paper, news articles, or even a textbook; but such opportunities are generally relatively limited. Supporting the nomination with additional "testimonials" may be the best way to show effectiveness and impact . . . but supporters should be urged to be as specific as possible. Comparable factors would also apply to other communicators - article writers, TV or movie producers, radio commentators, and so on.

They too will be judged on their effectiveness, impact, and influence. In these cases, the nomination might describe how a local series of "hit" science programs was picked up by the national media and broadcast all over the country. Perhaps a book with a science/technical theme by an Idaho author suddenly becomes a national bestseller. Maybe a lecturer from Idaho starts turning up on national public television, or becomes a "hot item" on the national lecture circuit. Such accomplishments could well qualify an individual for this award.

### **SUBMISSION INFORMATION**

Completed nomination packages (4 copies please) should be submitted by March 1, 2006 to the IAS Award Program Coordinator at:

Dr. Dwight Wray  
IAS Award Program Coordinator  
BYU-Idaho Dept. of Biology  
Rexburg, ID 83460-1100  
E-mail: [wrayd@byui.edu](mailto:wrayd@byui.edu)  
Phone: (208) 496-2004

Nominations will remain active for a period of two years; after that, the nomination package would need to be revised and re-submitted. Additional supporting information may be submitted for addition to a nomination that is already one year old.

### **SELECTION PROCESS**

Nominations will be reviewed by an ad hoc panel of at least three individuals, selected by the Academy President and Executive Director. If at all possible, the group will include individuals whose fields of expertise correspond to those of the nominees. That is, if nominees represent chemistry, science education, and civil engineering, then the panel should have representatives from each of those fields.

The panel will review all the nominations versus the criteria outlines above and makes a formal recommendation to the Executive Committee. The final decision on whether there will be an award, and to whom, will be made by the Executive Committee. The President will then contact the person(s) selected to make sure he or she will actually attend the Annual Meeting or have to accept the award in absentia.

## Idaho Academy of Science Membership Enrollment/Renewal Form

This information is used for the membership directory. Check here \_\_\_\_ if you do NOT want to be listed in the membership directory.

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Institution/Co: \_\_\_\_\_

Dept./Division: \_\_\_\_\_

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Fax: \_\_\_\_\_

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### **ANNUAL DUES:\*\***

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Institutions/Companies (Educational institutions, companies and other entities that hire employees): \_\_\_\_ \$125;

Library Subscriptions to the Journal of the IAS and The Retort. \_\_\_\_ \$20;

Additional contributions to the IAS Scholarship Fund or for general operation of the Academy are sincerely appreciated. Contributions to the IAS are tax deductible; hence, receipts will be provided upon request.

Send the above form and dues payment to:

Idaho Academy of Science  
909 Lucille Ave.  
Pocatello, ID 83201-2542

Additional inquiries may be directed by US Mail to the address above, by phone to (208) 234-7001, or by e-mail to: [IdAcadSci@aol.com](mailto:IdAcadSci@aol.com)

\*Campus or INEEL mail stops help save postage.

\*\* All of the above grades of membership include a subscription to the peer reviewed biannual Journal of the Idaho Academy of Science, a subscription to The Retort newsletter, all IAS announcements and special publications, and the right to register for all IAS Meetings at member rates. Make check payable to Idaho Academy of Science.

## INFORMATION FOR CONTRIBUTORS

Contributions to the JOURNAL OF THE IDAHO ACADEMY OF SCIENCE may be in all fields of science or science education which relate in some manner to the state of Idaho and have not been published elsewhere.

Manuscripts submitted (in triplicate) to the Editor should be doubled spaced throughout with ample margins and typed on only one side of the paper. Submit an electronic copy of the manuscript on a CD along with the paper copies. An email attachment containing the manuscript would also be appreciated. Regular articles include, in order, the following: title, author(s) name(s), author(s) address(es), abstract, key words, text (with desired headings), acknowledgements, literature cited, tables and figure legends. First mention of scientific names should include authority.

In brief articles, the text is not subdivided. The abstract should be complete and understandable without reference to the text. The scope of the article should be stated in the introduction or, in the case of brief articles, an introductory paragraph. Footnote material should be incorporated in the text whenever possible. Authors should follow the suggestions in the latest edition of the CBE Style Manual (AIBS) for abbreviations, punctuation, and similar matters. All numerical measurements should be given in the metric system with the English system following parenthetically where desirable.

Tables and figures should be kept within economic limits. Tables should be typed on separate sheets. Lettering and line drawings must be of letter quality (i.e. laser printing of India ink). Figures should be planned for no reduction when printed; thus, they may be no larger than 11 X 17 cm (4-1/2 6 3/4 inches). If photographs are submitted they must be hard glossy prints of good contrast. Legends must be brief; legends for figures should be placed on a single, separate sheet.

Page proof will be sent to the author. Reprints can be ordered when the author returns the proofs; 50 reprints of each article will be furnished free to IAS members. There will be a \$1 per reprint charge for nonmembers with a minimum order of 50. Illustrations will be destroyed unless their return is requested on the reprint order.

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