Wildl. Biol. 15: 106-112 (2009)
DOI: 10.2981/07-093

www.wildlifebiology.com

Short communication

The use of an orthotic casting foam as a track-plate medium for wildlife research and monitoring

Justin Hooper & Roy V. Rea

Track plates are an inexpensive, non-intrusive and widely used wildlife monitoring tool. Almost all track-plate media are not suited for use during rainy conditions, because rain or heavy dews can distort tracks or render the medium ineffective for registering further animal visitations. Furthermore, available track-plate media may also produce tracks of varying quality and hard-surfaced media produce inaccurate two-dimensional imprints. We experimented with the utility of using Biofoam™, a phenolic foam used in orthotics, as a track-plate medium. Domestic animals were utilized to produce track imprints on track plates constructed of casting foam, coarse sand, fine sand, very fine sand and sooted aluminum. Resulting tracks were photographed and images were used in a questionnaire which was completed by expert wildlife trackers who rated the quality of the tracks. Tracks in the casting foam are three-dimensional, register claws, clearly depict all pads, accurately record shape and size, and convey very fine anatomical details. Track imprints on the casting foam were rated consistently better by experts than track imprints left on the other media. Field trials demonstrated that the casting foam and tracks in the casting foam can endure lengthy periods of inclement weather conditions in the field without being damaged or distorted. In summary, where three-dimensional, high-quality prints need to be recorded in variable field conditions, we recommend the use and further experimentation with track plates made of casting foam.

Key words: Biofoam™, orthotic foam, track-plate media, track plates, wildlife tracking, wildlife tracks

Justin Hooper, Aleza Lake Research Forest, 3333 University Way, Prince George, British Columbia V2N 4Z9, Canada - e-mail: hooperj1@unbc.ca
Roy V. Rea, Natural Resources and Environmental Studies Institute, Ecosystem Science and Management Program, University of Northern British Columbia, 3333 University Way, Prince George, British Columbia V2N 4Z9, Canada - e-mail: reav@unbc.ca

Corresponding author: Roy V. Rea

Received 27 November 2007, accepted 20 May 2008

Associate Editor: Anne Loison

Monitoring animal populations is essential to various aspects of wildlife research and management (Engeman 2005). Wildlife sign surveys using track identification allow researchers to obtain animal presence, relative abundance and activity data (Hamm et al. 2003, Engeman 2005). Natural substrates at survey sites are often ineffective at capturing clear tracks (Glen & Dickman 2003), consequently wildlife researchers often import artificial or foreign media to construct track plates. The track plate is an appealing passive data collection method because it is relatively non-intrusive and inexpensive, and because it allows large areas to be surveyed (Hamm et al. 2003, Connors et al. 2005).

Track-plate media have been developed for track stations (Connors et al. 2005). The most commonly used materials are sand and sooted aluminum (Loukmas et al. 2003, Connors et al. 2005). The sand method consists of smoothing a thin layer of very fine sand directly on the ground or other substrate (Bider 1968). The carbon-soot method consists of using either a kerosene or acetylene gas flame to

uniformly distribute carbon soot over plates of aluminum, tin and galvanized steel (Mayer 1957, Justice 1961, Uresk et al. 2003). Alternative plate covers include talcum powder (Brown 1969), ink (Lord et al. 1970), lime (Linhart & Knowlton 1975), carpenter's chalk (Drennan et al. 1998), grease (Uresk et al. 2003), toner (Belant 2003), a carbon black-mineral oil mixture (Nams & Gillis 2003), and a graphite-alcohol-oil mixture applied on acetate sheets (Connors et al. 2005).

A disadvantage of all of the track-plate media outlined above, with the exception of the graphite-alcohol-oil mixture, is that rain, heavy dew or even fog can distort tracks and render the tracking medium ineffective (Bider 1968, Linhart & Knowlton 1975, Foresman & Pearson 1998, Mowat et al. 1999, Glen & Dickman 2003, Uresk et al. 2003, Connors et al. 2005). The graphite-oil-mixture is superior in water-resistance to other track-plate media, but is only resistant to moderate rainfall (<24 mm/day; Connors et al. 2005). Consequently, deploying track plates in rainy areas or during the wet season usually requires the construction of a rain shelter (e.g. rain cover, box or tunnel; Bider 1968, Elbroch 2003, Loukmas et al. 2003). Rain shelters can be costly (Connors et al. 2005), alter ordinary animal behaviour (Foresman & Pearson 1998, Loukmas et al. 2003, Connors et al. 2005) and/or confine the number of species able to traverse the plate (Loukmas et al. 2003).

Even during optimal conditions, traditional track media produce imprints of varying quality (Glen & Dickman 2003, Uresk et al. 2003). Imprints in sand are often of poor quality (Uresk et al. 2003) and unreliable for species recognition (Glen & Dickman 2003). Carbon-sooted plates are capable of producing high quality tracks, but only under dry conditions (Foresman & Pearson 1998, Elbroch 2003, Loukmas et al. 2003, Uresk et al. 2003). Tracks on carbon-sooted plates and other hard surfaces, however, are only two-dimensional and lack details about the size and shape of the imprint source (Taylor & Raphael 1988, Elbroch 2003) making species identification difficult (Taylor & Raphael 1988, Belant 2003).

In an effort to develop a water-proof medium which registers high-quality, three-dimensional tracks, we experimented with the utility of Biofoam^{TM} (Smithers Bio-medical Systems, Kent, OH) as a track-plate medium. Biofoam^{TM} is a non-toxic (Shults et al. 1988), non-skin irritating (Shults et al. 1989) expanded phenolic plastic manufactured for taking casts of human feet for orthotic purposes. This material captures detailed and accurate imprints of materials pressed into it as per its intended design which we hypothesized showed promise for use as a wildlife track-plate medium.

Material and methods

Lab testing

We tested the utility of Biofoam^{TM} as a track-plate medium relative to more traditional forms of track plates including coarse sand, fine sand, very fine sand and sooted aluminum plates. The foam track plates were constructed of standard issue Biofoam^{TM} casting sheets cut with a hack-saw blade into 2-cm thick pieces, which were then mounted to a half-inch plywood plate using duct tape. Coarse, fine and very fine sand plates were constructed by spreading and leveling sand to a depth of approximately 2 cm over a plywood tray. Following the methodology outlined by Bider (1968), sand was smoothed by lightly raking a bristle brush head covered with plastic over the sand surface. The carbon-soot plate was constructed by applying a uniform layer of carbon soot over a 0.50 cm thick aluminum plate. Soot was applied using an acetylene torch, with the torch tip modified to increase soot output by blocking the air intake holes. Soot application procedures followed the methods used by Uresk et al. (2003). All plates were approximately 60×90 cm.

Trials with several domestic animals took place on 23 August and 20 September, 2005, at the Society for the Prevention of Cruelty against Animals (SPCA) animal shelter in Prince George, British Columbia (53°53'02"N, 122°45'57"W), Canada. Our experimental procedure received approval from the Animal Care and Use Committee at the University of Northern British Columbia. Plates were placed within narrow dog running pens and inset into the ground so that the ground and plate surfaces were flush. We used four domestic animal species in our experiment: 1) four dogs weighing ~4 kg, ~10 kg, ~19 kg and ~41 kg, 2) three cats weighing ~6.5 kg, ~3 kg and ~0.25 kg, 3) a rabbit weighing ~3 kg, and 4) a rat weighing ~0.25 kg. The highest quality track on each medium produced by each individual was photographed using a digital camera (6.3 mega pixel Fuji Finepix S6000 fd, Mississauga, ON, Canada) set on the highest resolution and using the automatic macro-photography setting.

Animal responses

In an effort to ascertain various animal responses to the foam track plates during the SPCA trials, we videoed the first ~60 seconds of each animal's approach to the foam (and other media). Additionally, we transported plates of the casting foam to the Northern Lights Wildlife Shelter in Smithers, British Columbia, Canada, where we positioned plates in a cougar *Felis concolor* and a black bear *Ursus americanus* paddock, as well as in a pen with guinea pigs *Cavia porcellus* and domestic rabbits *Oryctolagus cuniculus*. Responses of these animals to the foam were each monitored for 20-30 minutes.

Questionnaire

Photographic (still) images from the SPCA trials only were used to develop a questionnaire designed to evaluate the quality of tracks taken by each medium. This questionnaire was approved by the UNBC Ethics Committee and sent to carefully selected participants who had one or both of the following qualifications: 1) had produced published scientific manuscripts or books on wildlife tracking, or 2) had extensive experience in wildlife tracking (i.e. tracking instructors or trappers). Participants were asked to view an image of plate imprints for all animals on all plate types and judge the quality of the tracks using a Likert scale of 1 (low quality) through 10 (high quality). Participants were encouraged to provide written comments justifying why tracks were rated in a particular manner.

Because experts in this field were difficult to contact and survey, we only obtained responses from five experts. Consequently, we only report descriptive statistics (mean and standard deviations) from our survey results and did not perform significance testing.

Field study

To assess various aspects of the performance of the foam track plates under field conditions, we also installed six foam plates mounted on plywood undercarriages on wildlife trails, a fallen log and a beaver dam located in the Aleza Lake Research Forest, British Columbia, Canada (54°05'10"N, 122°02'54"), during 3-24 October, 2005. We then collected and analyzed these plates to assess their utility for field use.

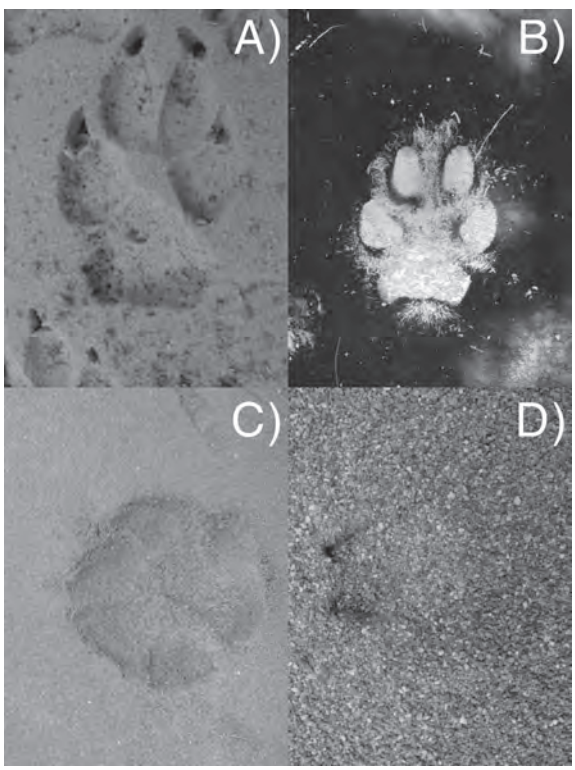

Figure 1. Highest rated track imprints for each medium: foam (A), soot (B), very fine sand (C), and coarse sand (D).

Results

Lab testing

We successfully captured images of track impressions from all of the animals trialed at the SPCA in all five media. The images were used to develop a survey that was subsequently sent out to experts for use in comparing the quality of track imprints. Images were arranged so that an easy comparison could be made by the expert in determining which track plate best captured the imprint (Fig. 1).

Animal responses

Observations and review of the video footage of animal responses to track-plate media revealed that trialed dogs showed no curiosity towards the media with the exception of the sooted aluminum. All of the dogs stopped and sniffed the sooted plates before crossing over them. Despite the lack of reaction from dogs to the casting foam, a black bear at the Northern Lights Wildlife Shelter left imprints on a foam plate, but did so only after sniffing, scratching and breaking up some of the material.

Two of the three cats tested appeared to be wary of the sinking sensation of the foam plates; they retracted their paws once they began to sink into

Table 1. Mean scores (and standard deviation; SD) of the quality of track impressions as ranked by experts on a scale from 1 to 10 (see Methods) from images of tracks made by individual animals on each different track-plate medium.

	Medium									
	Biofoam		Sooted aluminum		Very fine sand		Fine sand		Course sand	
Animal	Score	SD	Score	SD	Score	SD	Score	SD	Score	SD
Dog 1	8.3	0.59	4.0	1.39	4.0	1.24	4.4	0.48	3.1	1.82
Dog 2	7.9	2.33	7.5	1.24	6.3	1.14	4.2	1.44	1.3	0.39
Dog 3	6.7	3.03	8.7	0.59	3.5	1.96	1.5	0.76	1.0	0.00
Dog 4	9.2	0.96	6.2	1.80	4.9	2.29	3.3	1.63	2.4	0.78
Cat 1	9.2	0.94	6.6	1.92	4.6	1.92	4.6	1.00	1.6	7.80
Cat 2	8.4	0.99	8.5	0.88	5.4	1.47	4.8	1.30	1.6	0.48
Cat 3	4.8	1.44	8.4	0.48	5.1	1.71	1.8	0.73	1.3	0.39
Rat 1	6.9	2.11	5.0	2.05	6.2	2.27	4.0	2.56	1.8	0.73
Rabbit 1	6.9	1.53	2.8	1.30	4.4	2.11	2.6	1.59	1.2	0.39

the plate. A ~90 kg cougar at the Northern Lights Wildlife Shelter, however, acted oblivious to the foam, repeatedly crossing over and stepping into the plate as if it were not there. Rabbits and guinea pigs at the wildlife shelter reluctantly stepped on the plates after sniffing and nibbling on minute quantities.

Questionnaire

Of the five materials with which we experimented, the orthotic casting foam and sooted aluminum were on average ranked by experts as producing the best track impressions from all animals (Table 1). In six of nine cases, the foam plates ranked highest, albeit sooted aluminum performed nearly as well for registering the tracks of Dog 2 (see Table 1). Generally, all sand media performed poorly in comparison to casting foam and sooted aluminum. The average of all dog mean scores for casting foam was 8.03 while the average of all dog mean scores for sooted aluminum was 6.6. The average of all cat mean scores for casting foam was 7.46 while the average of all cat mean scores for sooted aluminum was 7.83.

Field study

Tracks of moose *Alces alces*, red squirrel *Tamiasciurus hudsonicus*, porcupine *Erethizon dorsatum*, pine marten or fisher (*Martes* spp.), beaver *Castor canadensis*, and merganser ducks *Mergus* spp. were all found on our foam plates following our three weeks of field testing. The majority of track imprints were of high quality with some tracks depicting very fine details. For example, the pebble-like dimpling of porcupine metacarpal pads was clearly visible in the foam (Fig. 2).

Some imprints had been distorted by other overlapping tracks where animal traffic was intense. In particular, one plate we mounted on a large fallen spruce *Picea* sp. tree had been repeatedly trampled by red squirrel; the hundreds of overlapping tracks made it difficult to decipher tracks from one another. Another plate set on an inclined beaver run (~45° slope), had most of the foam displaced from the board.

During the field trial, the foam plates were exposed to ~30 cm of rain, and air temperatures of -5 - +18°C. These weather conditions did not appear to affect the foam plates or the track imprints in any manner, with one exception: one of the foam plates had numerous minute dimples uniformly distributed over the plate surface, which appear to have been caused by hail.

In a separate test, running water from a tap on the foam plate for 10 minutes had no obvious affect on the plate or dog tracks imprinted in the plate. Furthermore, the wetted foam plate maintained its ability to register further impressions. Freezing the

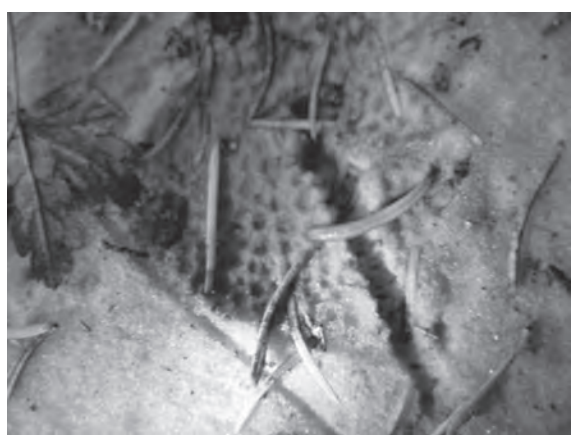

Figure 2. An impression of metacarpal dimpling from a porcupine captured by the foam track plate during field trials.

imprinted plate in a -20°C freezer had no obvious effect on any of the tracks or the foam itself, or the ability of the foam to register further imprints subsequent to thawing.

Discussion

Lab testing and questionnaire responses

Our findings demonstrate that track plates constructed of casting foam generally capture higher quality tracks than either sand or sooted aluminum. Sooted aluminum produced higher quality tracks than sand, and finer sand tended to produce higher quality tracks than coarser sand as reported by Bider (1968) and Uresk et al. (2003).

Our survey respondents commented on the ability of the casting foam to register claws and clearly depict all pads and negative spaces between pads (see Fig. 1), features known to be of crucial importance in track identification (Elbroch 2003). Accurate print shape and metrics are also critical in track analysis because track measurements are often used in identification (Elbroch 2003). Tracks produced using the carbon soot or other two-dimensional methods do not accurately represent an animal's imprint, and therefore must be measured and analyzed with caution (Taylor & Raphael 1988, Elbroch 2003). For this reason, drawings and measurements in standard animal track guidebooks are often unreliable and confusing (Taylor & Raphael 1988). Our respondents indicated that track outlines in sand were ambiguous and appeared enlarged, which agreed with the findings of Uresk et al. (2003). The casting foam, on the other hand, as per its intended use, registers accurately the shape and metrics of an animal's foot.

Some respondents commented in favour of the three-dimensionality of the casting foam and sand tracks even when viewing two-dimensional images. One respondent stated that he/she could actually visualize the source animal's foot while viewing the tracks in the foam plates. Although not tested here, track casts in three dimensions also allow for easier separation of overlapping tracks (Foresman & Pearson 1998).

Occasionally, foot hair was retained in the foam material, presumably pinched and plucked out by the collapsed foam. Although an unintentional by-product of using the foam track plates, hair samples left in the foam plates may be of some use in species identification. Overall, the clear, complete, three-dimensional and accurate tracks registered in the foam material appear to be superior to track impressions left in both the sand and sooted aluminum plates.

Animal responses

Animal wariness to survey devices is an important consideration and researchers should minimize behavioural biases to survey techniques (Gese 2004). Odour is one of the short comings inherent in using some traditional track-plate media (Boonstra & Krebs 1976, Connors et al. 2005). The observed stopping and sniffing of the sooted aluminum by all domestic dogs in our trials indicates that the odour of the acetylene soot was indeed obvious and of interest to these individuals. Our observations indicate that bears and guinea pigs were wary of the foam plates, but the dogs and other animals tested showed no response to the casting foam.

Our results indicate that caution must be taken when using foam plates for detecting natural animal behaviour/movements. Furthermore, our test subjects were either domestic or captive animals, and we did not investigate behavioural responses in wildlife. Therefore, the recommendation by Gompper et al. (2006) to use a secondary independent technique to check for behavioural biases when conducting wildlife surveys is an appropriate next-step in the testing of foam track plates.

Field study

Our findings indicate that foam plates withstood inclement weather such as heavy rainfall, hail and freezing temperatures while retaining imprints clearly. Although not tested specifically, it is reasonable to assume based on past researcher experience (Bider 1968, Linhart & Knowlton 1975, Foresman & Pearson 1998, Mowat et al. 1999, Glen & Dickman 2003, Uresk et al. 2003) that sand and sooted-plates do not stand up as well as our foam plates to these weather conditions.

Foam plates are susceptible to overvisitation and track distortion due to trampling; this weakness is also common to other media (Foresman & Pearson 1998). Our results also indicate that it is important to mount foam plates on a level surface, because angled plates may result in foam being sloughed off during trampling. Regardless of these limitations, foam plates appear to be more weather-durable than reports of other track-plate media presented in the literature. Even during moderate rain exposure, foam plates did not require rain shelters, thus avoiding the behavioural biases that can be associated

with the use of covered media (Foresman & Pearson 1998, Loukmas et al. 2003).

Conclusions and recommendations

Overall, our plates constructed of casting foam appear to have numerous operational advantages over the other track-plate media tested. Constructing foam plates requires foam, lumber and duct tape. This is not the case for sooted aluminum, which requires specialized and potentially dangerous equipment (Belant 2003, Uresk et al. 2003). Unlike other plates (Connors et al. 2005), foam plates are prepared easily before going into the field. Plates are light weight and easy to transport relative to other media. Track impressions cast in foam can also be archived and later referenced, which is not feasible with most of the other media (Connors et al. 2005).

Plates constructed of casting foam are economical relative to other plate media, e.g. construction of a 60×90 cm foam plate, including plywood, is about $US 3.00; it costs $US 2.00 to replace the foam. Furthermore, the lack of maintenance required and the lack of a requirement for an expensive rain shelter further lowers operational costs. Our results show that foam plates are suitable for a variety of different-sized animals and captured track impressions from animals as small as guinea pigs (500-1,000 g) and as large as moose (400-500 kg).

Although more rigorous field testing is recommended, track plates constructed of casting foam are water-proof, can endure a variety of field conditions and appear to be useful for capturing high-quality, three-dimensional tracks. As such, we recommend that ecologists begin to use this medium for wildlife monitoring and research, particularly if the researcher desires to obtain high-quality three-dimensional tracks and/or monitor activity in rainy environments without the use of rain shelters.

Acknowledgements - we thank the questionnaire participants, Alcan Aluminum (Kitimat, BC), Praxair Welding Supplies (Prince George, British Columbia), Melanie Karjala and the Aleza Lake Research Forest, and Wenbiao Zhang for statistical consultation. We also thank the Prince George Chapter of the SPCA and Angelika and Peter Langen at the Northern Lights Wildlife Shelter in Smithers, British Columbia. Finally, we thank Claude Miaud and an anonymous reviewer for comments on an earlier draft of this paper.

References

Belant, J.L. 2003: Comparison of 3 tracking media for detecting forest carnivores. - Wildlife Society Bulletin 31: 744-747.

Bider, J.R. 1968: Animal activity in uncontrolled terrestrial communities as determined by a sand transect technique. - Ecological Monographs 38: 269-308.

Boonstra, R. & Krebs, C. 1976: The effect of odour on trap response in *Micro townsendii*. - Journal of Zoology 180: 467-476.

Brown, L.E. 1969: Field experiments on the movement of *Apodemus sylvaticus* using trapping and tracking techniques. - Oecologia 2: 198-222.

Connors, M.J., Schauber, E.M., Forbes, A., Jones, C.G., Goodwin, B.J. & Ostfield, R.S. 2005: Use of track plates to quantify predation risk at small spatial scales. - Journal of Mammalogy 86: 991-996.

Drennan, J.E., Beier, J.E. & Dodd, N.L. 1998: Use of tracking of tracking stations to index abundance of sciurids. - Journal of Mammalogy 79: 352-359.

Elbroch, M. 2003: Mammal Tracks & Sign: A Guide to North American Species. - Stackpole Books, Mechanicsburg, PA, 400 pp.

Engeman, R.M. 2005: Indexing principles and a widely applicable paradigm for indexing animal populations. - Wildlife Research 32: 203-210.

Foresman, K.R. & Pearson, D.E. 1998: Comparison of proposed survey procedures for detection of forest carnivores. - Journal of Wildlife Management 62: 1217-1226.

Gese, E.M. 2004: Survey and Census Techniques for Canids. - USDA National Research Center-Staff Publications, 9 pp.

Glen, A.S. & Dickman, C.R. 2003: Monitoring bait removal in vertebrate pest control: a comparison using track identification and remote photography. - Wildlife Research 30: 29-33.

Gompper, M.E., Kays, R.W., Ray, J.C., LaPoint, S.D. & Bogan, D.A. 2006: A Comparison of non-invasive techniques to survey carnivore communities in Northeastern North America. - Wildlife Society Bulletin 34: 1142-1151.

Hamm, K.A., Diller, L.V., Klug, R.R. & McDonald, T.L. 2003: Spatial independence of fisher (*Martes pennanti*) detections at track plates in Northwestern California. - American Midland Naturalist 149: 201-210.

Justice, K.E. 1961: A new method for measuring home ranges of small mammals. - Journal of Mammalogy 42: 462-470.

Linhart, S.B. & Knowlton, F.F. 1975: Determining the relative abundance of coyotes by scent station lines. - Wildlife Society Bulletin 3: 119-124.

Lord, R.D., Vilches, J.I., Maiztegui, J.I. & Soldini, C.A. 1970: The tracking board: a relative census technique

for studying rodents. - Journal of Mammalogy 51: 828-829.
Loukmas, J.J., Mayack, D.T. & Richmond, M.E. 2003: Track plate enclosures: box designs affecting attractiveness to riparian mammals. - The American Midland Naturalist 149: 219-224.
Mayer, W.V. 1957: A method for determining the activity of burrowing mammals. - Journal of Mammalogy 38: 531
Mowat, G., Shurgot, C. & Poole, K. 1999: Using track plates, remote cameras and hair removal to detect marten and short-tailed weasels in coastal cedar hemlock forests. - Northwestern Naturalist 31: 113-121.
Nams, V.O. & Gillis, E.A. 2003: Changes in tracking tube use by small mammals over time. - Journal of Mammalogy 84: 1374-1380.
Shults, S.K., Roblin, M.C., Wilson, N.H. & Killeen, J.C. 1988: Acute oral toxicity (LD50) study in rats with Oasis Standard Floral Foam. - Ricera, INC., Department of Toxicology and Animal Metabolism, 18 pp.
Shults, S.K., Roblin, M.C., Wilson, N.H. & Killeen, J.C. 1989: Primary dermal irritation study in albino rabbits with Oasis Standard Foam. - Ricerca, INC., Department of Toxicology and Animal Metabolism, 16 pp.
Taylor, C.A. & Raphael, M.G. 1988: Identification of mammal tracks from sooted track stations in the Pacific Northwest. - California Fish and Game 74: 4-15.
Uresk, D., Severson, K.E. & Javersak, J. 2003: Detecting smoked-plate scent stations versus spotlighting. - Research Paper, RMRS-RP-39, Ogden UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, 5 pp.