

Recreation Ecology Research in the Americas

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From its origin in the United States and United Kingdom, recreation ecology as a field of study is over 70 years old and has grown to include a large international audience of scientists and protected area managers. Though there are few full-time recreation ecologists, the number of studies investigating recreation and visitor impacts has grown substantially in the past decade and a recent annotated bibliography included 1108 references (Leung, 2005). This paper provides a brief characterization and review of recent recreation ecology research in the Americas. Due to the large number and diverse array of relevant studies this review is largely limited to characterizing the recent research topics and publications of those scientists most active in recreation ecology research. Recent reviews providing a more comprehensive discussion of this literature include Cole (2004a), Hammitt and Cole (1998), and Leung and Marion (2000).

Canada

The most active recreation ecology research in Canada has been at the University of Guelph, Ontario, where Dr. Doug Larson directs a Cliff Ecology Research Group. This program has been very active in investigating the ecological impacts of rock climbers (Kelly & Larson 1997, McMillan, Nekola & Larson 2003, McMillan & Larson 2002). Other recent recreation ecology studies include investigations on visitor impacts to the intertidal zone (Alessa, Bennet, & Kliskey 2003), using GIS to determine suitability for hiking trails (Bridgland, Lemky & Allen 2001), mountain biking impacts to vegetation and soil (Thurston & Reader 2001), campsite impact monitoring (Peregoodoff 1998), chemical

impacts to soils from campfires and dishwashing (Arocena, Nepal & Rutherford 2006), and a study of human disturbance on duck nests (Olson & Rohwer 1998).

United States

Land management agencies of the federal government are the primary source of funding for recreation ecology research in the U.S. Specifically, the National Park Service and Forest Service are the primary sponsors, with relatively few dollars available from other federal agencies, conservation foundations, state parks and forests, and private sources. Only the U.S. Forest Service has provided permanent "hard money" funding supporting recreation ecology research; most funding is for specific studies requested by land managers. Consequently, recreation ecology research continues to be very applied, generally focused on providing information for carrying capacity decision making or resolving recreation impact problems.

Numerous government and university scientists conduct occasional recreation ecology studies. However, only four U.S. scientists consider the primary focus of their program of research to be recreation ecology; two of these are employees of the federal government. The following discussion describes their recent and current research studies to illustrate the focus of the most active research programs. Many other studies have been conducted and published but are too numerous to include here.

David Cole is a U.S. Forest Service scientist with the Aldo Leopold Wilderness Research Institute in Montana. While the bulk of his research has focused on camping impacts and experimental trampling, he has recently broadened his work to

include studies of wilderness visitors and non-recreational threats to wilderness ecosystems. Recent recreation ecology studies include studies of camping impacts (Cole & Monz 2004a,b) and basic research on factors that limit natural recovery of campsites (Zabinski & Cole 2000) and evaluating the effectiveness of alternative restoration techniques (Zabinski, Wojtowicz & Cole 2000, Zabinski et al. 2002). He has also authored many recent syntheses of recreation ecology knowledge, including Hampton and Cole (2003), Cole (2004 a,b), Newsome, Cole and Marion (2004), and Gutzwiller and Cole (2005).

The author is a U.S. Geological Survey scientist stationed at Virginia Tech, a university in Virginia. He conducts studies in wilderness, national park backcountry and frontcountry settings, and in international protected natural areas. His early research and some continuing studies investigate camping impacts (Marion & Farrell 2002, Reid & Marion 2004, Reid & Marion 2005). Recent research has focused on trail degradation and management (Marion & Leung 2004), particularly soil erosion (Aust, Marion & Kyle 2005, Marion & Olive 2006), and methodological innovations for assessing trail conditions (Marion & Leung 2001, Marion, Leung & Nepal In Press). Other recent studies have investigated the efficacy of low impact education (Daniels & Marion In Press a, Marion & Reid In Press) and how visitors gauge the appropriateness of site management actions to limit visitor impacts (Cahill, Marion & Lawson In Press, Daniels & Marion In Press, b). Two current studies are examining rock climbing impacts, including collaboration with Chris Carr, a recreation ecology doctoral candidate at the University of Cincinnati.

Yu-Fai Leung is an Associate Professor at North Carolina State University in their Parks, Recreation, and Tourism Management program. His recent studies have focused on trail degradation (see studies cited in preceding paragraph), the selection and monitoring of recreation impact indicators (Leung, Marion & Cole 2002, Leung & Meyer 2004) and the efficacy of low impact education (Leung & Attarian 2002, Leung

& Attarian 2003, Wirsching, Leung & Attarian 2003). Other recent and related research has examined the application of geospatial technologies to visitor impact assessments (Leung, Shaw, Johnson & Duhaime 2002).

Chris Monz is an Assistant Professor at St. Lawrence University, New York, in their Environmental Studies program. His current research interests include the assessment and management of human impacts to parks with a particular focus on backcountry visitor use in high latitude or elevation environments (Cole & Monz 2002, Forbes, Monz & Tolvannen 2004, Monz & Twardock 2004, Monz 2002) and shoreline use on the Atlantic coast (Monz, Young & Leung 2004, Monz, Leung, Ingle & Bauman 2004).

Richard Knight, a wildlife scientist at Colorado State University, is also active in recreation ecology research, including several recent studies investigating visitor impacts to wildlife (Miller, Knight, & Miller 2001, Taylor & Knight 2003, Camp & Knight 1998).

Central and South America – Numerous recreation ecology studies have been conducted in Central and South American countries over the last decade though most are not reported in the more widely available peer-reviewed literature. The author has been involved in several studies of trail impacts in Belize, Costa Rica, Chile and Peru (Farrell & Marion 2000, 2001, 2002b, Marion & Linville 2000), recreation site impacts in Belize, Costa Rica and Mexico (Farrell & Marion 2000, 2001, Olive 2005), and development of a simplified carrying capacity decision-making process for protected natural areas (Farrell & Marion 2002a). Other similar studies include a study of soil erosion on trails in Ecuador and Costa Rica (Wallin & Harden 1996), trail and recreation site impact assessments at popular tourism sites in Dominica (Christian 1996), campsite monitoring in the Baja region of Mexico (Monz 1998), and recreation impact assessments related to implementation of carrying capacity planning at a park in Patagonia, Argentina (Encabo, Torre & Bergallo 2001).

Other studies have examined the impacts of visitation on wildlife, which are a principal feature of interest for nature-based tourists. These include

scuba diving impacts to Caribbean coral and fish communities (Hawkins et al. 1999), the effects of motorized tourboats on flamingos in Yucatan, Mexico (Galicia & Baldassarre 1997), impacts to wild pygmy marmosets in Ecuador (De la Torre, Snowdon & Bejarano 2000), and an assessment of wildlife densities in visited and unvisited areas of a popular Mayan ruin park in Guatemala (Hiding-er 1996).

References

- Alessa, L., Bennett, S.M. & Kliskey, A.D. (2003). Effects of knowledge, personal attribution and perception of ecosystem health on depreciative behaviors in the intertidal zone of Pacific Rim National Park and Reserve. In: *Journal of Environmental Management* (68/2), p 207-218.
- Arocena, J.M., Nepal, S.K. & Rutherford, M. (2006). Visitor-induced changes in the chemical composition of soils in backcountry areas of Mt Robson Provincial Park, British Columbia, Canada. In: *Journal of Environmental Management* (79), p 10-19.
- Aust, M.W., Marion, J.L. & Kyle, K. (2005). Research for the Development of Best Management Practices for Minimizing Horse Trail Impacts on the Hoosier National Forest. In: *Management Report. USDA, Forest Service, Final Report. Bedford.*
- Bridgland, J., Lemky, K. & Allen D. (2001). Use of field-verified GIS classification to determine landscape suitability for hiking trail development. In: *Managing protected areas in a changing world: Proceedings of the 4th International Conference on Science and Management of Protected Areas, May 14-19, 2000, p 1470-1479. Wolfville.*
- Cahill, K., Marion, J.L. & Lawson, S. (In Press). Enhancing the interpretation of stated choice tradeoff analysis through the application of a verbal protocol assessment. In: *Journal of Leisure Research.*
- Camp, R.J., & Knight, R.L. (1998). Rock climbing and cliff bird communities at Joshua Tree National Park, California. In: *Wildlife Society Bulletin* (26/4), p 892-98.
- Christian, C.S. (1996). *Outdoor Recreation and Nature Tourism Related Environmental Impacts in a Tropical Island Setting: Commonwealth of Dominica.* PhD Dissertation, Clemson University.
- Cole, D.N. (2004a). Environmental Impacts of Outdoor Recreation in Wildlands. In: Manfredo, M., Vaske, J., Field, D, Brown, P. & Bruyere, B. (ed.) *Society and Resource Management: A Summary of Knowledge*, p 107-116. Jefferson City.
- Cole, D.N. (2004b). Impacts of hiking and camping on soils and vegetation: a review. In: Buckley, Ralf (ed.) *Environmental Impacts of Ecotourism*, p 41-60. Wallingford.
- Cole, D.N. & Monz, C.A. (2002). Trampling disturbance of subalpine vegetation, Wind River Mountains, Wyoming. In: *Arctic, Antarctic and Alpine Research* (34/4), p 365-376.
- Cole, D.N. & Monz, C.A. (2004a). Impacts of camping on vegetation: Response of acute and chronic disturbance on vegetation. In: *Environmental Management* (32/6), p 693-705.
- Cole, D.N. & Monz, C.A. (2004b). Spatial patterns of recreation impact on experimental campsites. In: *Journal of Environmental Management* (70), p 73-84.
- Daniels, M.L. & Marion, J.L. (In Press, a). Communicating Leave No Trace Ethics and Practices: Efficacy of two-day Trainer Courses. In: *J. of Park and Recreation Administration*
- Daniels, M.L. & Marion, J.L. (In Press, b). Visitor evaluations of management actions at a highly impacted Appalachian Trail camping area. In: *Environmental Management.*
- De la Torre, S., Snowdon, C.T. & Bejarano, M. (2000). Effects of human activities on wild pygmy marmosets in Ecuadorian Amazonia. In: *Biological Conservation* (94/2), p 153-163.
- Encabo, M. Torre, G., & Bergallo, A. (2001). Management of conservation in spaces of recreational use. In: *International Journal of Hospitality and Tourism Administration* (1/3-4), p 43-51.
- Farrell, T.A. & Marion, J.L. (2000). Identification and management of visitor impact problems within protected areas in Costa Rica and Belize. In: Harmon, D. (ed.) *On the Frontiers of Conservation: Proceedings of the 10th Conference on Research and Resource Management in Parks and on Public Lands, The George Wright Society Biennial Conference March 22-26, 1999, Asheville, NC*, p 62-67. Hancock.
- Farrell, T.A. & Marion, J.L. (2001). Identifying and assessing ecotourism visitor impacts at selected protected areas in Costa Rica and Belize. In: *Environmental Conservation* (28/3), p 215-225.
- Farrell, T.A. & Marion, J.L. (2002a). The Protected Areas Visitor Impact Management (PAVIM) framework: A simplified process for making management decisions. In: *Journal of Sustainable Tourism* (10/1), p 31-51.
- Farrell, T.A. & Marion, J.L. (2002b). Trail impacts and trail impact management related to ecotourism visitation at Torres del Paine National Park, Chile. In: *Leisure/Loisir: Journal of the Canadian Association for Leisure Studies* (26/1-2), p 31-59.

- Forbes, B.C., Monz C.A., & Tolvannen, A. (2004). Impacts of Ecotourism in Polar Environments. In: Buckley, R. (editor) *The Environmental Impacts of Ecotourism*, p 155-170. London.
- Galicia, E. & Baldassarre, G.A. (1997). Effects of motorized tourboats on the behavior of nonbreeding American flamingos in Yucatan, Mexico. In: *Conservation Biology* (11/5), p 1159-1165.
- Gutzwiller, K.J. & Cole, D.N. (2005). Assessment and Management of Wildland Recreational Disturbance. In: Braun, C.E. (ed.) *Wildlife Management Techniques Manual*, p 779-796. Bethesda.
- Hammitt, W.E. & Cole, D.N. (1998). *Wildland Recreation: Ecology and Management*. New York.
- Hampton, B., & Cole, D.N. (2003). *Soft Paths: How to Enjoy the Wilderness without Harming It*. Harrisburg.
- Hawkins, J.P., Callum, M.R., Hof, T.V., Meyer, K., Tratalos, J. & Aldam, C. (1999). Effects of recreational scuba diving on Caribbean coral and fish communities. In: *Conservation Biology* (13/4), p 888-897.
- Hidinger, L.A. (1996). Measuring the Impacts of Ecotourism on Animal Populations: A Case Study of Tikal National Park, Guatemala. In: Malek-Zadeh, E. (ed.) *The Ecotourism Equation: Measuring the Impacts*, Bulletin Series (99), p 49-59. New Haven.
- Kelly P.E. & Larson D.W. (1997). Effects of rock climbing on populations of presettlement eastern white cedar (*Thuja occidentalis*) on cliffs of the Niagara Escarpment, Canada. In: *Conservation Biology* (11), p 1125-1132.
- Leung, Y.-F. (2005). *Recreation Ecology and Visitor Impact Research – An Annotated Bibliography*. Final Report, USDA Forest Service, Rocky Mountain Research Station.
- Leung, Y.-F. & Attarian, A. (2002). Evaluating the Effectiveness of the Leave No Trace Program in the City of Durango, Colorado. Final report submitted to the Leave No Trace, Inc., Boulder, CO.
- Leung, Y.-F. & Attarian, A. (2003). Frontcountry visitor information/education programs: Are there lessons for wilderness? In: *International Journal of Wilderness*, (9/1), p 32-33.
- Leung, Y.-F., Marion, J.L., & Cole, D.N. (2002). Visitor impact assessment and monitoring systems: Evolution and current development. In: Bondrup-Nielsen, S. and N. Munro (ed.), *Managing Protected Areas in a Changing World: Proceedings of the 4th International Conference on Science and Management of Protected Areas*; May 14-19, 2000; Waterloo, Ontario, Canada, p 213-220. Wolfville.
- Leung, Y.-F. & Meyer, K. (2004). Research to Support Development of Resource Indicators and Standards for Implementing the Visitor Experience and Resource Protection (VERP) Framework at Boston Harbor Islands, A National Park area. Final report submitted to USDI National Park Service, Boston Harbor Islands National Park Area.
- Leung, Y.-F., Shaw, N., Johnson, K., & Duhaime, R. (2002). More than a database: Integrating GIS data with the Boston Harbor Islands visitor carrying capacity study. In: *The George Wright Forum* (19/1), p 69-78.
- Marion, J.L. & Farrell, T. (2002). Management practices that concentrate visitor activities: Camping impact management at Isle Royale National Park, USA. *Journal of Environmental Management* (66/2), p 201-212.
- Marion, J.L. & Leung, Y.-F. (2001). Trail resource impacts and an examination of alternative assessment techniques. *Journal of Park and Recreation Administration* (19/3), p 17-37.
- Marion, J.L. & Leung, Y.-F. (2004). Environmentally Sustainable Trail Management. In: Buckley, R. (ed.), *Environmental Impact of Tourism*, p 229-244. Cambridge.
- Marion, J.L., Leung, Y.-F. & Nepal, S. (In Press). Monitoring trail conditions: new methodological considerations. In: *George Wright Forum*.
- Marion, J.L. & Linville, R. (2000). Trail Impacts and their Management in Huascaran National Park, Andes Mountains, Peru. Report Issued by The Mountain Institute and the Virginia Tech College of Natural Resources Cooperative Park Studies Unit, Blacksburg, VA.
- Marion, J.L. & Olive, N. (2006). Assessing and Understanding Trail Degradation: Results from Big South Fork National River and Recreational Area. In: USDI, National Park Service, Research/Resources Mgmt. Rpt., Big South Fork National River and Recreation Area. Onieda.
- Marion, J.L. & Reid, S.E. (In Press). Minimizing visitor impacts to protected areas: The efficacy of low impact education programs. In: *Journal of Sustainable Tourism*.
- McMillan, M.A., & Larson, D.W. (2002). The effects of rock climbing on the vegetation of the Niagara Escarpment in Southern Ontario, Canada. In: *Conservation Biology* (16), p 389-398.
- McMillan, M.A., Nekola, J.C., & Larson, D.W. (2003). Effects of rock climbing on the land snail community of the Niagara Escarpment in southern Ontario, Canada. In: *Conservation Biology* (17), p 616-621.
- Miller, S.G., Knight, R.L. & Miller, C.K. (2001). Wildlife responses to pedestrians and dogs. In: *Wildlife Society Bulletin* (29), p 124-132.
- Monz, C.A. (1998). Monitoring recreation resource impacts in two coastal areas of western North America: An initial assessment. In: Watson, A.E., Alphet, G., & Hen-

- dee, J.C. (comps.). *Personal, Societal and Ecological Values of Wilderness: Sixth World Wilderness Congress Proceedings on Research, Management and Allocation* (1), p 117-122. Ogden.
- Monz, C.A. (2002). The response of arctic tundra plant communities to human trampling disturbance. In: *Journal of Environmental Management* (64), p 207-217.
- Monz, C.A. Leung, Y.-F., Ingle, C. & Bauman, H. (2004). Visitor Impact Monitoring in the Coastal and Barrier Island Network. In: Harmon, D., Kilgore, B. & Vietzke, G. (ed.) *Protecting our diverse heritage: The role of parks, protected areas and cultural sites. Proceedings of the George Wright Society/ National Park Service Joint Conference April 14-18, 2003*, p 135-139.
- Monz, C.A. & Twardock, P. (2004). The Resource Impacts of Sea Kayak Use in Prince William Sound, Alaska. In: Buckley, R. (ed.) *The Environmental Impacts of Ecotourism*, p 309-316. London.
- Monz, C.A., Young, E.A. & Leung, Y. (2004). Monitoring the impacts of visitors to shorebird populations in the Coastal and Barrier Island Network areas. In: Bricker, K. (ed.). *Proceedings of the 2004 Northeastern Recreation Research Symposium*, p 373-377. Newton Square.
- Newsome, D., Cole, D. & Marion, J. (2004). Environmental Impacts Associated with Recreational Horse Riding. In: Buckley, R. (ed.) *Environmental impacts of ecotourism*, p 61-82. Wallingford.
- Olive, N. (2005). An Assessment of Coastal Recreation Site Conditions in the Gulf of California and Baja Peninsula, Mexico: A Gulf Area Monitoring Program. In: *National Outdoor Leadership School Report*. Lander.
- Olson, R. & Rohwer, F.C. (1998). Effects of human disturbance on the success of artificial duck nests. In: *Journal of Wildlife Management* (62/3), p 1142-1146.
- Peregoodoff, G. (1998). Recreation impact monitoring of coastal campsites in Gwaii Haanas National Park Reserve/Haida Heritage Site. In: Munro, N.W. & Wilison, J.H. (ed.) *Linking Protected Areas with Working Landscapes Conserving Biodiversity: Proceedings of the Third International Conference on Science and Management of Protected Areas*, Calgary, p 967-971. Wolfville.
- Reid, S.E. & Marion, J.L. (2004). Effectiveness of a confinement strategy for reducing campsite impacts in Shenandoah National Park. In: *Environmental Conservation* (31/4), p 274-282.
- Reid, S.E. & Marion, J.L. (2005). A comparison of campfire impacts and policies in seven protected areas. In: *Environmental Management* (36/1), p 48-58.
- Taylor, A.R. & Knight, R.L. (2003). Wildlife responses to recreation and associated visitor perceptions. In: *Ecological Applications* (13/4), p 951-963.
- Thurston, E. & Reader, R.J. (2001) Impacts of experimentally applied mountain biking and hiking on vegetation and soil of a deciduous forest. In: *Environmental Management* (27/3), p 397-409.
- Wallin, T.R. & Harden, C.P. (1996). Estimating trail-related soil erosion in humid tropics: Jatun Sacha, Ecuador, and La Selva, Costa Rica. In: *Ambio* (25/8), p 517-522.
- Wirsching, A., Leung, Y.-F. & Attarian, A. (2003). Swatting little bugs: What agencies can do to decrease depreciative visitor behavior. In: *Parks and Recreation* (38/11), p 16-22.
- Zabinski, C. & Cole, D. (2000). Understanding the factors that limit restoration success on a recreation-impacted subalpine site. In: Cole, D.N., McCool, S.F., Borrie, W.T. & O'Loughlin, J., comps. *Wilderness science in a time of change conference, Vol. 5: Wilderness ecosystems, threats, and management; 2000 May 23-27; Missoula, MT. Proceedings*, p 216-221. Ogden.
- Zabinski, C.A., DeLuca, T.H, Cole, D.N. & Moynahan, O.S. (2002). Restoration of highly impacted subalpine campsites in the Eagle Cap Wilderness, Oregon. In: *Restoration Ecology* (10/2), p 275-281.
- Zabinski, C., Wojtowicz, T. & Cole, D. (2000). The effects of recreation disturbance on subalpine seed banks in the Rocky Mountains of Montana. In: *Canadian Journal of Botany* (78/5), p 577-582.