

COURSE: Fall 2016, FISH 7350, Meta-analysis, 2 credit hours

LECTURE: Mondays, 2:00-4:00 pm CT, Upchurch 301

OFFICE HOURS: Available by appointment

REQUIRED PREREQUISITES: Graduate students, postdocs, faculty; via instructor approval

INSTRUCTOR: Dr. Alan Wilson, Swingle 321, wilson@auburn.edu, 334-246-1120

ZOOM: We will use Zoom for distance education-based lectures. You can access Scopia here - <https://auburn.zoom.us/j/9922610946>

FIELD OF STUDY:

Meta-analysis is a quantitative approach for synthesizing results from diverse research studies that address a similar hypothesis. Effect sizes calculated from individual studies are combined to elucidate general patterns across studies. Like most approaches, meta-analysis has limitations (e.g., file drawer problem, dealing with varying publication quality). However, the technique can be a powerful option for identifying patterns in disciplines where the availability of large, under-analyzed datasets is common, such as ecology, psychology, medicine, and education.

COURSE OBJECTIVES & STUDENT LEARNING PHILOSOPHY:

The course objectives represent a variety of tasks and skills that I expect students to have developed and mastered by the end of the course. Through participating in this course, you will (1) practice and develop your critical thinking skills (through in-class group discussions and presentations), (2) learn how to read and interpret the scientific literature, (3) broaden your understanding of meta-analysis, and (4) conduct your own meta-analysis.

REQUIRED MATERIALS (PROVIDED BY INSTRUCTOR AND STUDENTS):

- (1) Articles from the peer-reviewed literature (see complete list at end of syllabus)
- (2) R software (download it here <https://www.r-project.org/>)

GRADING:

Course grades are based on each student's cumulative performance for the following assignments:

<u>Activity</u>	<u>Points</u>	<u>Grading scale</u>
Attendance	10	A = 90-100%
Participation	10	B = 80-89%
Paper discussion	25	C = 70-79%
Project presentation	25	D = 60-69%
<u>Paper</u>	<u>30</u>	<u>F = 0-59%</u>
Total points	100	

STUDENT EXPECTATIONS:

The course grade will be based on participation in lecture, discussion leading of important papers in meta-analysis, and a final project presentation as described below:

- (1) ATTENDANCE: Participation is critical to success in this course. In order to participate, you need to be at class on-time and prepared (i.e., perused readings, practice with software).
- (2) PARTICIPATION: Discussion is vital to an effective learning environment and participation grades will reflect involvement during classroom activities. Student need to think about papers and lectures critically and provide thoughtful questions and comments during each lecture.
- (3) PAPER DISCUSSION: All students will be required to lead the discussion of a series of articles from the peer-reviewed literature during one class period.
- (4) PROJECT PRESENTATION: All students will be required to present a 10-minute lecture describing a meta-analysis that they conduct during the course. Brief 1 page outlines of the project will be due by the sixth week of the course so that I can assist with project development. The students are expected to use the primary literature as references and data sources for this presentation. Students producing successful projects will be strongly encouraged to submit their papers to a peer-reviewed journal.
- (5) PAPER: All students will be required to submit a ~10 page paper associated with their meta-analysis project. The paper should be prepared with submission to a journal in mind. Formatting should be specific to the target journal.

FEEDBACK & EVALUATION:

This course is for you to learn important fundamental concepts and ideas on which to build your understanding of meta-analysis. Course evaluations will be completed by students at the end of the semester so that course changes can be made to enhance the learning experience for this class and future classes. Finally, students are always welcome to schedule a meeting with me to talk more about topics discussed in class.

COURSE CHANGES:

Although I expect to cover all the topics described in the syllabus, course changes will likely occur - especially based on feedback from the students. Consequently, I reserve the right to modify the course to enhance the learning experience where I deem appropriate. Course changes will be described verbally during class and/or in writing via email and/or handouts.

ACADEMIC HONESTY:

The Auburn University Student Academic Honesty Code (available at <https://sites.auburn.edu/admin/universypolicies/Policies/AcademicHonestyCode.pdf>) clearly defines the university's honesty code. I expect all students to conduct themselves in my class with this Code in mind

ACCOMMODATIONS FOR DISABILITIES:

If you have a disability and/or a special need that requires accommodations, please inform me immediately so that I can develop a plan to work with you and arrange an appointment with a campus disabilities counselor.

LECTURE SCHEDULE AND ASSOCIATED READINGS (CITATIONS FOLLOW):

<u>Day</u>	<u>Lecture topic</u>
22 Aug	Introduction to meta-analysis; historical overview Discussion leader – Alan Glass 1976; Gurevitch et al. 2001; Arnqvist and Wooster 1995, Cooper et al. 1990; Finney 1995; Osenberg and St. Mary 1998
29 Aug	Limitations of meta-analysis Discussion leaders – Jessica Gilpin, Ed Burress Eysenck 1994; Walker et al. 2008; Hillebrand and Cardinale 2010; Møller and Jennions 2001; Marshall et al. 2004; Bailar 1997; Eysenck 1984; Lecky et al. 1996;
5 Sept	LABOR DAY – NO CLASS
12 Sept	Where to find data? How to choose data? Discussion leaders – Erica Molina, Jeremy McAdam, Lauren Lindsey Englund et al. 1999; Bown and Sutton 2010; Arnqvist and Wooster 1995; Kissling and Davis 2009; Nelson and Kennedy 2009; Neber et al. 2001; Slavin 1995 BASIC R TRAINING WITH ERIC BAUER BEFORE CLASS
19 Sept	How to choose an effect size metric? *Student project outlines due and brief intro* Discussion leaders – Susan Rashid, Pandora Wadsworth, Eric Bauer Nakagawa and Cuthill 2007; Maher et al. 2013; Mengerson and Gurevitch 2013; Harrison 2011; Borenstein et al. 2009 (chaps3-8); Hedges et al. 1999; Osenberg et al. 1997; Osenberg et al. 1999 BASIC R TRAINING WITH ERIC BAUER BEFORE CLASS
26 Sept	Standard statistics and meta-analysis; (ir)relevance of null hypotheses & P-values Discussion leaders – Shamim Naigaga, Marike Visser, Jennifer Weber Murtaugh 2014; Burnham et al. 2014; Cohen 1994; Johnson 1999; Fernandez-Duque 1997; Borenstein et al. 2009 (chapter 16); Gurevitch and Hedges 1999 BASIC R TRAINING WITH ERIC BAUER BEFORE CLASS
3 Oct	Introduction to R for Meta-Analysis and advanced meta-analysis statistics Discussion leader – Ash Normand 1999; van Houwelingen et al. 2002
10 Oct	Meta-analysis examples Discussion leaders – Melissa Singletary, Steve Dobson, David Held Wilson et al. 2006; Kollock et al. 2016
17 Oct	Meta-analysis examples Discussion leaders –Dani Carroll, Kaitlin McGinnis Kollock et al. 2015; Montero-Castano and Vila 2012

- 24 Oct** **Meta-analysis examples**
Discussion leaders – Angelina Haines, Jeff Roth
ArchMiller et al. 2015
- 31 Oct** **Meta-analysis examples**
Discussion leaders – Jennifer Price, Anna Tucker
Complete online survey
- 7 Nov** **Meta-analysis examples**
Discussion leaders – Lydia Moore, Romi Novriadi, Carter Ullman
Nado et al. 2015; Hua 2013; Salze et al. 2011; Tusevljak et al. 2012
- 14 Nov** **Meta-analysis examples**
Discussion leaders – Charlotte Levy, Shelby Zikeli
Guo and Gifford 2002; Civitello et al. 2010
- 21 Nov** **THANKSGIVING BREAK – NO CLASS**
- 28 Nov** **Meta-analysis examples**
Final student presentations for CARTER, PANDORA, MARIKE
Discussion leaders – Julia Hu, Xiaozhu Wang, Pan Wang
Paul et al. 2010; Koricheva and Gurevitch 2014; Evangelou and Ioannidis 2013
- 1 Dec** **Final student presentations**
THURS
- 5 Dec** **Final student presentations; Final paper due; *course evaluation***

EXAMPLE READINGS (ALSO GO LOOK IN “PAPERS” FOLDER IN DROPBOX):

- ArchMiller, A. A., E. F. Bauer, R. E. Koch, B. K. Wijayawardena, A. Anil, J. J. Kottwitz, A. S. Munsterman, and A. E. Wilson. 2015. Formalizing the definition of meta-analysis in *Molecular Ecology*. *Molecular Ecology* 24(16):4042-4051.
- Arnqvist, G., and D. Wooster. 1995. Meta-analysis - synthesizing research findings in ecology and evolution. *Trends in Ecology and Evolution* 10:236-240.
- Bailar, J. C. 1997. The promise and problems of meta-analysis. *New England Journal of Medicine* 337:559-561.
- Balvanera, P., A. B. Pfisterer, N. Buchmann, J. S. He, T. Nakashizuka, D. Raffaelli, and B. Schmid. 2006. Quantifying the evidence for biodiversity effects on ecosystem functioning and services. *Ecology Letters* 9:1146-1156.
- Benayas, J. M. R., A. C. Newton, A. Diaz, and J. M. Bullock. 2009. Enhancement of biodiversity and ecosystem services by ecological restoration: a meta-analysis. *Science* 325:1121-1124.
- Borenstein, M., L. V. Hedges, J. P. T. Higgins, and H. R. Rothstein. 2009. *Introduction to meta-analysis*. John Wiley and Sons.
- Bown, M. J. and A. J. Sutton. 2010. Quality control in systematic reviews and meta-analyses. *European Society for Vascular Surgery* 40:669-677.
- Brett, M. T., and C. R. Goldman. 1996. A meta-analysis of the freshwater trophic cascade. *Proceedings of the National Academy of Sciences of the United States of America* 93:7723-7726.
- Burnham, K. P. and D. R. Anderson. 2014. P values are only an index to evidence: 20th vs. 21st century statistical advice. *Ecology* 95(3):627-630.
- Caporaso, J. G., C. L. Lauber, W. A. Walters, D. Berg-Lyons, C. A. Lozupone, P. J. Turnbaugh, N. Fierer, and R. Knight. 2011. Global patterns of 16S rRNA diversity at a depth of millions of sequences per sample. *Proceedings of the National Academy of Sciences of the United States of America* 108:4516-4522.
- Cardinale, B. J., D. S. Srivastava, J. E. Duffy, J. P. Wright, A. L. Downing, M. Sankaran, and C. Jouseau. 2006. Effects of biodiversity on the functioning of trophic groups and ecosystems. *Nature* 443:989-992.
- Carmona, D., M. J. Lajeunesse, and M. T. J. Johnson. 2011. Plant traits that predict resistance to herbivores. *Functional Ecology* 25:358-367.
- Castanho, C. D., C. J. Lortie, B. Zaitchik, and P. I. Prado. 2015. A meta-analysis of plant facilitation in coastal dune systems: responses, regions, and research gaps. *Peerj* 3.
- Chamberlain, S. A., S. M. Hovick, C. J. Dibble, N. L. Rasmussen, B. G. Van Allen, B. S. Maitner, J. R. Ahern, L. P. Bell-Dereske, C. L. Roy, M. Meza-Lopez, J. Carrillo, E. Siemann, M. J. Lajeunesse, and K. D. Whitney. 2012. Does phylogeny matter? Assessing the impact of phylogenetic information in ecological meta-analysis. *Ecology Letters* 15:627-636.
- Civitello, D. J., E. Rynkiewicz, and K. Clay. 2010. Meta-analysis of co-infections in ticks. *Israel Journal of Ecology & Evolution* 56:xx-xx.
- Conord, C., J. Gurevitch, and B. Fady. 2012. Large-scale longitudinal gradients of genetic diversity: a meta-analysis across six phyla in the Mediterranean basin. *Ecology and Evolution* 2:2595-2609.
- Cooper, S. D., S. J. Walde, and B. L. Peckarsky. 1990. Prey exchange-rates and the impact of predators on prey populations in streams. *Ecology* 71:1503-1514.

- Downing, J. A., C. W. Osenberg, and O. Sarnelle. 1999. Meta-analysis of marine nutrient-enrichment experiments: variation in the magnitude of nutrient limitation. *Ecology* 80:1159-1167.
- Elser, J. J., M. E. S. Bracken, E. E. Cleland, D. S. Gruner, W. S. Harpole, H. Hillebrand, J. T. Ngai, E. W. Seabloom, J. B. Shurin, and J. E. Smith. 2007. Global analysis of nitrogen and phosphorus limitation of primary producers in freshwater, marine and terrestrial ecosystems. *Ecology Letters* 10:1135-1142.
- Englund, G., O. Sarnelle, and S. D. Cooper. 1999. The importance of data-selection criteria: Meta-analyses of stream predation experiments. *Ecology* 80:1132-1141.
- Evangelou, E. and J. P. A. Ioannidis. 2013. Meta-analysis methods for genome-wide association studies and beyond. *Nature Reviews Genetics* 14:379-389.
- Eysenck, H. J. 1984. Meta-Analysis - an Abuse of Research Integration. *Journal of Special Education* 18:41-59.
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- Glass, G. V. 1976. Primary, secondary, and meta-analysis of research. *Educational Researcher* 5:3-8.
- Gomez-Aparicio, L., and C. J. Lortie. 2014. Advancing plant ecology through meta-analyses. *Journal of Ecology* 102:823-827.
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- Gurevitch, J., and L. V. Hedges. 1999. Statistical issues in ecological meta-analyses. *Ecology* 80:1142-1149.
- Gurevitch, J., J. A. Morrison, and L. V. Hedges. 2000. The interaction between competition and predation: A meta-analysis of field experiments. *American Naturalist* 155:435-453.
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- Halaj, J., and D. H. Wise. 2001. Terrestrial trophic cascades: how much do they trickle? *American Naturalist* 157:262-281.
- Harpole, W. S., J. T. Ngai, E. E. Cleland, E. W. Seabloom, E. T. Borer, M. E. S. Bracken, J. J. Elser, D. S. Gruner, H. Hillebrand, J. B. Shurin, and J. E. Smith. 2011. Nutrient co-limitation of primary producer communities. *Ecology Letters* 14:852-862.
- Hedges, L. V., J. Gurevitch, and P. S. Curtis. 1999. The meta-analysis of response ratios in experimental ecology. *Ecology* 80:1150-1156.
- Hillebrand, H. 2004. On the generality of the latitudinal diversity gradient. *American Naturalist* 163:192-211.
- Hillebrand, H., and B. J. Cardinale. 2010. A critique for meta-analyses and the productivity-diversity relationship. *Ecology* 91:2545-2549.
- Hillebrand, H., and J. Gurevitch. 2014. Meta-analysis results are unlikely to be biased by differences in variance and replication between ecological lab and field studies. *Oikos* 123:794-799.

- Hua, K. 2013. Estimating maintenance amino acids requirements of fish through a nonlinear mixed modelling approach. *Aquaculture Research* 44:542-553.
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- Kollock, R., K. Games, A. E. Wilson and J. Sefton. 2015. Effects of vehicle-ride exposure on cervical pathology: a meta-analysis. *Industrial Health* 53:197-205.
- Kollock, R., C. Andrews, A. Johnston, T. Elliott, A. E. Wilson, K. Games, and J. Sefton. 2016. A meta-analysis to determine if lower extremity muscle strengthening should be included in military knee overuse injury prevention programs. *Journal of Athletic Training* 51(4):xx-xx.
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- Murtaugh, P. A. 2014. In defense of *P* values. *Ecology* 95(3):611-617.

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- Nakagawa, S., R. Poulin, K. Mengersen, K. Reinhold, L. Engqvist, M. Lagisz, and A. M. Senior. 2015. Meta-analysis of variation: ecological and evolutionary applications and beyond. *Methods in Ecology and Evolution* 6:143-152.
- Nakagawa, S., and E. S. A. Santos. 2012. Methodological issues and advances in biological meta-analysis. *Evolutionary Ecology* 26:1253-1274.
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- Osenberg, C. W., O. Sarnelle, and S. D. Cooper. 1997. Effect size in ecological experiments: the application of biological models in meta-analysis. *American Naturalist* 150:798-812.
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- Tusevjack, N.A. Rajic, L. Waddell, L. Dutil, N. Cernicchiaro, J. Greig, B. J. Wilhelm, W. Wilkins, S. Totton, F. C. Uhland, B. Avery, and S. A. McEwen. 2012. Prevalence of zoonotic bacteria in wild and farmed aquatic species and seafood: a scoping study, systematic review, and meta-analysis of published research. 9(6):487-497.
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PUBLICATIONS FROM PAST META-ANALYSIS (FISH 7350) COURSES (2010, 2012, 2014)

(student authors in **bold**; Google Scholar citations, where available, as of 14 February 2016)

16. **Willoughby, J. R.**, M. Sundaram, **B. K. Wijayawardena**, M. C. Lamb, S. J. A. Kimble, Y. Ji, N. B. Fernandez, J. D. Antonides, N. J. Marra, and J. A. DeWoody. Biome and migratory behavior significantly influence vertebrate genetic diversity. Biological Journal of the Linnean Society.

LINK [http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1095-8312](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1095-8312)

15. **Hrycik, A. R.**, **L. Z. Almeida**, and T. O. Höök. In press. Sub-lethal effects on fish provide insight into a biologically-relevant threshold of hypoxia. Oikos.

LINK ([http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1600-0706](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1600-0706))

(CITATIONS = 0) (Impact factor = 3.586)

14. Kollock, R., **K. Games**, A. E. Wilson, and J. Sefton. In press. The effects of vehicle-ride exposure on fatigue at the spinal musculature: a meta-analysis. Journal of Athletic Training.

LINK (<http://natajournals.org/toc/attr/0/0>)

(CITATIONS = 0) (Impact factor = 2.017)

13. **Munsterman, A. S.**, **J. J. Kottwitz**, and R. R. Hanson. 2016. Meta-analysis of the effects of adhesion barriers on adhesion formation in the horse. Veterinary Surgery 45:587-595.

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(CITATIONS = 0) (Impact factor = 1.041)

12. Kollock, R., C. Andrews, A. Johnston, T. Elliott, A. E. Wilson, **K. Games**, and J. Sefton. 2016. A meta-analysis to determine if lower extremity muscle strengthening should be included in military knee overuse injury prevention programs. Journal of Athletic Training 51(4):xx-xx.

<http://natajournals.org/doi/pdf/10.4085/1062-6050-51.4.09>

(CITATIONS = 0) (Impact factor = 2.017)

11. **McGill, J.**, F. Adler-Baeder, and P. Rodriguez. In press. Mindfully in love: A meta-analysis of the association between mindfulness and relationship satisfaction. Journal of Human Sciences and Extension 4(1):89-101.

http://media.wix.com/ugd/c8fe6e_65448e5da9754a6c8676f179d07067d1.pdf

(CITATIONS = 0) (Impact factor = N/A)

10. **Koch, R. E.**, A. E. Wilson, and G. E. Hill. 2016. The importance of carotenoid dose in supplementation studies with songbirds. Physiological and Biochemical Zoology 89(1):61-71.

<http://www.jstor.org/stable/10.1086/684485>

(CITATIONS = 0) (Impact factor = 2.398)

9. **Willoughby, J. R.**, M. Sundaram, **B. K. Wijayawardena**, S. J. A. Kimble, Y. Ji, N. B. Fernandez, J. D. Antonides, M. C. Lamb, N. J. Marra, and J. A. DeWoody. 2015. The reduction of genetic diversity in threatened vertebrates and new recommendations regarding IUCN conservation rankings. Biological Conservation 191:495-503.

<http://www.sciencedirect.com/science/article/pii/S000632071530032X>

(CITATIONS = 0) (Impact factor = 3.762)

8. ArchMiller, A. A., E. F. Bauer, R. E. Koch, B. K. Wijayawardena, A. Anil, J. J. Kottwitz, A. S. Munsterman, and A. E. Wilson. 2015. Formalizing the definition of meta-analysis in *Molecular Ecology*. *Molecular Ecology* 24(16):4042-4051.
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