Literature review for tradeoff paper

Context for our paper

(Werner et al., 1993) - A majority of animal populations (80%) have complex life cycles, and therfore, theoretical ecologists are interested in modeling the fitness consequences of variation in timing of life history events underlying such complexity.

Theoretical work

The following papers address the theoretical aspects of life history trade offs.

(Birt et al., 2009) - Paper explores SS models for organisms with non-geometric development times. Addresses the interaction between the environment and development time. Important paper because it is describes a similar effort. They present an extension to the stage classified model so organisms with arbitrary means and sd can be modeled. The goal of this paper is to generalize the negative binomial case so that organisms with general mean and variance of development times can be modeled. Predictable changes in predation mortality as a consequence of changes in food availability and predation risk From the discussion: Variation in development time might be an adaptive response to living in areas with fluctuating conditions.

(Caswell, 2001) Two extensions to the stage classified model. 1) A variable stage duration model and 2) negative binomial stage duration model.

(Caswell, 2011) - Another theoretical paper that provides a mathematical approach towards teasing out individual heterogeneity in matrix models. Studies use incorrect measures (variability in lifetime reproduction) as an indicator of individual heterogeneity. This is often incorrect and only valid if the actual hetergeneity in the population exceeded this variability. This paper presents a new approach to address this problem. It works for age- or stage-classified models, to constant, periodic, or stochastic environments, and to any kind of reproductive schedule.

Bet Hedging

(Beaumont et al., 2009) - A prominent, well-cited paper in Nature that addresses the issue of evolution of bet hedging. Persistence in the face rapidly changing environments, which can result in the evolution of adaptations and expression of stochastic phenotypes, such that at least a subset of the population will express a favorable phenotype. In this case, they show experimental demonstration of de novo evolution of BH.

(Childs et al., 2010) - A nice, comprehensive review on the evolution of bet hedging stategies. worth citing to represent the breadth of the topic.

(Young et al., 1991) - A TREE review that reviews empirical support for evolution of semelparity and reviews various models (including but not limited to bet hedging).

(Rubenstein, 2011) - Bet hedging in the context of cooperative breeding.

(Wilbur et al., 2006) - Address questions surrouding the conditions under which selection would favor iteroparity versus semelparity.

(Crean et al., 2009) - An empirical study testing the idea of dynamic bet hedging using data from 5 previously analyzed populations. Find support in all studies and conclude that dynamic bet hedging is more common than expected.

(Perrin, 1993) - A comprehensive ARES review.

Life-history and phylogeny

(Burns et al., 2010) - Phylogenetic comparison of variation in life-history traits. But this is an empirical test of life history evolution. They found greater sensitivity and lower variation in survival than in fecundity, which they find to be consistent with the buffering of important vital rates. So when considering variability in vital rates, one must also take phylogeny into account.

> Variation in life histories is the result of differences in selection caused by differences in the surrounding environment and may be constrained by trade-offs between different vital rates, rates that describe the movement of individuals through the life cycle such as survival and fecundity (Caswell 2001), and by phylogeny.

Growth x reproduction trade off

(Bouwhuis et al., 2010) - empirical study demonstrating decline in reproductive performace with age. They are exploring heterogeneity in rates of senescence among individuals. They explore these links to detect the underlying adaptive processes. Data is from Great Tits. high levels of early rep. are tied to lower late age repro. So there is an early versus late trade off.

(Stover et al., 2012) - They use a continuous-time model to address the trade off between mortality and reproduction.

(Haymes et al., 2012) - Empirical study looking at individual variation and reproductive output.

(Heino et al., 1997) - Evolution of semelparity.

Growth x survival trade off

(Wearing et al., 2004) - Examines the tradeoff between adult survival and growth. In this context the author is looking at shifts in trade offs between a native and an introduced range and documents a case of shift from semelparity to iteroparity

(YEARSLEY et al., 2004) - Unlike (Mangel et al., 2001), this paper but the covers the issue of time-delays and to the costs of growth has not been addressed despite evidence suggesting they do exist and are important for population/ecosystem level consequences.

(Mangel et al., 2001) - present a review of the trade-off between growth and survival and provide mathematical arguments for the maintenance of intrapopulation variability in individual development times.

(Anholt et al., 1988) - An example concerns the trade-off between foraging activities and an elevated risk of predation. The general result is that animals with high growth rates experience higher risk of mortality than animals with low growth rates; this often leads to an intermediate level of foraging effort that is a balance between the risk of predation and the risk of starvation. (Houston et al., 1993) is similar.

(Ydenberg, 1989; Rowe et al., 1991) Rowe is a heavily cited paper in Ecology exploring the optimization of growth versus survival trade off.

(Abrams et al., 1996) Theoretical exploration of the growth versus juvenile survival tradeoff.

Addresing the idea of correlation among stages.

We've discussed the idea that invididuals growing fast through a single stage are likely to move quickly through subsequent stages. (Zuidema et al., 2009) addresses this issue. (Aragón et al., 2010) is another empirical example.

Other relevant references

(González-Suárez et al., 2011) - An important paper making the link between of individual variation on population dynamics.

(Clark et al., 2007) - An empirical paper that examines the trade off between reproduction and survival for 23 bird species. There is no heterogeneity in their models and the paper is of limited use in our context (other than to make the case that empirical work such as this could benefit from more realistic models).

(Dochtermann et al., 2012) - Individual variation in life history traits is often ignored. They point out that there have been numerous theoretical papers

addressing this issue, the empirical side has been quite lacking. Show some evidence that individual variation can affect population stability.

(Doebeli et al., 1997) addresses the issue of timing in discrete life history models and how it alters the outcome of trade offs, especially when dealing with survival and reproduction. Does not address the issue of heterogeneity.

(Vindenes et al., 2011) - They provide a general theoretical framework for analyzing how individual heterogeneity caused by different biological mechanisms affects fluctuations of es- pecially small populations.

(Wilson et al., 2010) - A TREE review that also makes the case for the consideration of individual variation in population ecology and demography but focuses on clarifying the definiton of the term and the various contexts in which it is used.

(Kendall et al., 2002; Kendall et al., 2003; FOX et al., 2006; Kendall et al., 2011) - Discusses alternatives to structured population models that incorporate some form of heterogeneity. On the same vein, a paper that I wrote with Chris Dugaw (Dugaw et al., 2011)

(Jager, 2001) - empirical study examines the impact of maturation rate on population persistence. Individual variation increased this likelihood. (Huss et al., 2007), is another empirical example.

(Haymes et al., 2012) - Empirical study looking at the evolution of semelparity x iteroparity in the beet species complex.

(Filin et al., 2007) - Another paper like Manuel-Gonzalez, linking individual variation to population dynamics.

Literature list

Abrams, P. A., Leimar, O., Nylin, S., & Wiklund, C. 1996. The Effect of Flexible Growth Rates on Optimal Sizes and Development Times in a Seasonal Environment. The American Naturalist 147:381.

Anholt, B. R., & E, W. E. 1988. Predictable changes in predation mortality as a consequence of changes in food availability and predation risk. Evolutionary Ecology Research 12:729–738.

Aragón, C. F., Méndez, M., & Escudero, A. 2010. Linkages among life-history components through time: Carryover effects on the demography of a short-lived polycarpic plant. American journal of botany 97:1492–7.

Beaumont, H. J. E., Gallie, J., Kost, C., Ferguson, G. C., & Rainey, P. B. 2009. Experimental evolution of bet hedging. Nature 462:90–3.

Birt, A., Feldman, R. M., Cairns, D. M., Coulson, R. N., Tchakerian, M., Xi, W., & Guldin, J. M. 2009. Stage-structured matrix models for organisms with non-geometric development times. Ecology 90:57–68.

Bouwhuis, S., Charmantier, A., Verhulst, S., & Sheldon, B. C. 2010. Individual variation in rates of senescence: natal origin effects and disposable soma in a wild bird population. The Journal of animal ecology 79:1251–61.

Burns, J. H., Blomberg, S. P., Crone, E. E., Ehrlén, J., Knight, T. M., Pichancourt, J.-B., Ramula, S., et al. 2010. Empirical tests of life-history evolution theory using phylogenetic analysis of plant demography. Journal of Ecology 98:334–344.

Caswell, H. 2001. *Matrix Population Models: Construction, Analysis and Interpretation*. Sinauer Associates Inc., Sunderland,MA.

Caswell, H. 2011. Beyond R0: Demographic Models for Variability of Lifetime Reproductive Output. (W. M. Getz, Ed.)PLoS ONE 6:20809.

Childs, D. Z., Metcalf, C. J. E., & Rees, M. 2010. Evolutionary bet-hedging in the real world: empirical evidence and challenges revealed by plants. Proceedings of the Royal Society B: Biological Sciences 277:3055–64.

Clark, M. E. E., & Martin, T. E. E. 2007. Modeling tradeoffs in avian life history traits and consequences for population growth. Ecological Modelling 209:110–120.

Crean, A. J., & Marshall, D. J. 2009. Coping with environmental uncertainty: dynamic bet hedging as a maternal effect. Philosophical Transactions of the Royal Society B: Biological Sciences 364:1087–96.

Dochtermann, N. A., & Gienger, C. M. 2012. Individual variability in life-history traits drives population size stability. Current Zoology.

Doebeli, M., & Blarer, A. 1997. A note on the timing of tradeoffs in discrete life history models. Journal of Evolutionary Biology 10:107.

Dugaw, C. J., & Ram, K. 2011. Individual heterogeneity in mortality mediates long-term persistence of a seasonal microparasite. Oecologia 166:317–25.

FOX, G. A., KENDALL, B. E., FITZPATRICK, J. W., & WOOLFENDEN, G. E. 2006. Consequences of heterogeneity in survival probability in a population of Florida scrub-jays. Journal of Animal Ecology 75:921–927.

Filin, I., & Ovadia, O. 2007. Individual size variation and population stability in a seasonal environment: a discrete-time model and its calibration using grasshoppers. The American naturalist 170:719–33.

González-Suárez, M., Le Galliard, J.-F., Claessen, D., González-suárez, A. M., Galliard, J.-f. L., Bolnick, E. D. I., & Mcpeek, E. M. A. 2011. Population and Life-History Consequences of Within-Cohort Individual Variation. The American Naturalist 178:525–537.

Haymes, K. L., & Fox, G. A. 2012. Variation among individuals in cone production in Pinus palustris (Pinaceae). American journal of botany 99:640–5.

Heino, M., Metz, J. a. J., & Kaitala, V. 1997. Evolution of mixed maturation strategies in semelparous life histories: the crucial role of dimensionality of feedback environment. Philosophical Transactions of the Royal Society B: Biological Sciences 352:1647–1655.

Houston, A. I., McNamara, J. M., & Hutchinson, J. M. C. 1993. General Results concerning the Trade-Off between Gaining Energy and Avoiding Predation. Philosophical Transactions of the Royal Society B: Biological Sciences 341:375–397.

Huss, M., Persson, L., & Byström, P. 2007. The origin and development of individual size variation in early pelagic stages of fish. Oecologia 153:57–67.

Jager, H. I. 2001. Individual variation in life history characteristics can influence extinction risk. Ecological Modelling 144:61–76.

Kendall, B. E., & Fox, G. A. 2002. Variation among Individuals and Reduced Demographic Stochasticity. Conservation Biology 16:109–116.

Kendall, B. E., & Fox, G. A. 2003. Unstructured Individual Variation and Demographic Stochasticity. Conservation Biology 17:1170–1172.

Kendall, B. E., Fox, G. A., Fujiwara, M., & Nogeire, T. M. 2011. Demographic heterogeneity, cohort selection, and population growth. Ecology 92:1985–1993.

Mangel, M., & Stamps, J. 2001. Trade-offs between growth and mortality and the maintenance of individual variation in growth. Evolutionary Ecology Research 583–593.

Perrin, N. 1993. Dynamic Models of Energy Allocation and Investment. Annual Review of Ecology and Systematics 24:379–410.

Rowe, L., & Ludwig, D. 1991. Size and Timing of Metamorphosis in Complex Life Cycles: Time Constraints and Variation. Ecology 72:413.

Rubenstein, D. R. 2011. Spatiotemporal environmental variation, risk aversion, and the evolution of cooperative breeding as a bet-hedging strategy. Proceedings of the National Academy of Sciences of the United States of America 108 Suppl :10816–22.

Stover, J. P., Kendall, B. E., & Fox, G. A. 2012. Demographic heterogeneity impacts density-dependent population dynamics. Theoretical Ecology 5:297–309.

Vindenes, Y., Engen, S., & Saether, B.-E. 2011. Integral projection models for finite populations in a stochastic environment. Ecology 92:1146–1156.

Wearing, H. J., Rohani, P., Cameron, T. C., & Sait, S. M. 2004. The dynamical consequences of developmental variability and demographic stochasticity for host-parasitoid interactions. The American naturalist 164:543–58.

Werner, E. E., & Anholttt, B. R. 1993. Ecological Consequences of the Trade-Off between Growth and Mortality Rates Mediated by Foraging Activity. American Naturalist 142:242–272.

Wilbur, H. M., & Rudolf, V. H. W. 2006. Life-history evolution in uncertain environments: bet hedging in time. The American naturalist 168:398–411.

Wilson, A. J., & Nussey, D. H. 2010. What is individual quality? An evolutionary perspective. Trends in ecology & evolution 25:207–14.

YEARSLEY, J. M., KYRIAZAKIS, I., & GORDON, I. J. 2004. Delayed costs of growth and compensatory growth rates. Functional Ecology 18:563–570.

Ydenberg, R. C. 1989. Growth-Mortality Trade-Offs and the Evolution of Juvenile Life Histories in the Alcidae. Ecology 70:1494.

Young, T. P., & Augspurger, C. K. 1991. Ecology and evolution of long-lived semelparous plants. Trends in ecology & evolution 6:285–9.

Zuidema, P. a, Brienen, R. J. W., During, H. J., & Güneralp, B. 2009. Do persistently fast-growing juveniles contribute disproportionately to population growth? A new analysis tool for matrix models and its application to rainforest trees. The American naturalist 174:709–19.