Cale, W. G., Henebry, G. M., & Yeakley, J. A. (1989). Inferring process from pattern in natural communities. *BioScience*, *39*(9), 600-605.

-need to account for ecological processes, can’t make progress just from observing patterns

-ecological patterns are not isometric – same pattern can arise from different processes. Non-random processes can produce patterns that look random

<https://onlinelibrary.wiley.com/doi/full/10.1111/j.1600-0706.2009.17630.x>

**I can't define the niche but I know it when I see it: a formal link between statistical theory and the ecological niche**

If you define the fundamental niche by non-biotic interaction, then obligate parasites or mutualists have no fundamental niche

<https://academic.oup.com/sysbio/article/59/3/298/1702346>

Godsoe, W. (2010). Regional variation exaggerates ecological divergence in niche models. *Systematic Biology*, *59*(3), 298-306.

the ecological niche is only one of the forces shaping distributions.

Maxent and BRT performed much better than GLM in a series of comparisons of available methods (Elith et al. 2006), and so it is somewhat puzzling that in this case, BRT and maxent produced inferior predictions. **A plausible explanation for this pattern is that GLM incorporates more information on the relationship between the environmental variables and the probability that a species is present.** GLM requires the user to specify how individual variables shape the probability that a species will be present (specifying, e.g., that there are linear and squared terms). Neither BRT nor Maxent requires this much detail and so have less information to extrapolate to new environments

**4 papers that review state of thinking about sdms and climate chnage**

Wiens, J.A. et al. 2009. Niches, models, and climate change: assessing the assumptions and uncertainties. Proc. Natl. Acad. Sci. USA 106: 19729–19736.

Hijmans, R.J. & C.H. Graham. 2006. The ability of climate envelope models to predict the effect of climate change on species distributions. Glob. Change Biol. 12: 2272–2281.

Jeschke, J.M. &D.L. Strayer. 2008. Usefulness ofbioclimatic models for studying climate change and invasive species. Ann. N.Y. Acad. Sci. 1134: 1–24.

Peterson, A. T., Cobos, M. E., & Jiménez‐García, D. (2018). Major challenges for correlational ecological niche model projections to future climate conditions. *Annals of the New York Academy of Sciences*, *1429*(1), 66-77.

-p74 – opinions on why correlational niche models might be more effective than other options (trait-based, rules, mechanistic)

-worldclim data is best synchronized with future climate datasets, which is why it is often used for climate change predictions

-p71: AIC and omission rate don’t necessarily agree. They suggest testing with independent data first, then filtering with AIC

-uncertainty was concentrated in certain geographical areas

“Eco-logical niche models should be developed on a one-by-one basis, with customized estimation or assumptions about the M area for each species,15premodeling assessment of BAM scenarios,18eval-uation of extrapolation necessary for a particular model transfer,17”

A particular gap in knowledge is how model transferability compares with the predictive ability in the present day—the focus of most model evaluations.

Austin, M. 2007. Species distribution models and ecological theory: a critical assessment and some possible new approaches. Ecol. Model.200:1–19.

**Other random papers that I looked at and decided to put it off**

Zhu, G.-P. & A.T. Peterson. 2017. Do consensus models outperform individual models? Transferability evaluations of diverse modeling approaches for an invasive moth. Biol. Invasions 19: 2519–2532.

Owens, H.L. et al. 2013. Constraints on interpretation of ecological niche models by limited environmental ranges on calibration areas. Ecol. Model. 263: 10–18.

Osorio-Olvera, Luis. (2019). On population abundance and niche structure. Ecography (Copenhagen). (42)8. p.1415 - 1425.

Cooper, J. C., & Soberón, J. (2018). Creating individual accessible area hypotheses improves stacked species distribution model performance. *Global ecology and biogeography*, *27*(1), 156-165.

Owens, H. L., Campbell, L. P., Dornak, L. L., Saupe, E. E., Barve, N., Soberón, J., ... & Peterson, A. T. (2013). Constraints on interpretation of ecological niche models by limited environmental ranges on calibration areas. *Ecological modelling*, *263*, 10-18.

-combinational extrapolation = variable values existed originally, but combination didn’t

-strict extrapolation = values didn’t exist

-ways to estimate what portion of the niche is missing (similar to that paleo study I liked)

McLoughlin et al 2010: consider including density as a random effect

Comparing papers that are for or against Eltonian Noise Hypothesis

Background - *Soberon and Nakamura 2009. Niches and distributional areas: Concepts, methods, and assumptions*

**\*\*\*\*\* finish searches for relevant papers. i.e. “eltonian noise hypothesis spatial scale”**

**SUPPORTS**

*Tingley et al. 2009. Birds track their Grinnellian niche through a century of climate change*

*Soberon (2007) Grinnellian and Eltonian niches and geographic distributions of species. Ecol Lett 10:1115–1123.*

*???? Pearson RG, Dawson TP (2003) Predicting the impacts of climate change on the distribution of species: Are bioclimatic envelopes useful? Global Ecol Biogeogr12:361– 371.*

??? *Whittaker, R. J. et al. 2001. Scale and species richness: towards a general, hierarchical theory of species diversity. – J. Biogeogr. 28: 453–470.*

*Fraterrigo et al 2014. Local-scale biotic interactions embedded in macroscale climate drivers suggest Eltonian noise hypothesis distribution patterns for an invasive grass*

**REJECTS**

*Sofaer et al 2018. Misleading prioritizations from modelling range shifts under climate change*

*Leathwick JR, Austin M (2001) Competitive interactions between tree species in New Zealand’s old-growth indigenous forest. Ecology 82:2560–2573.*

*Bullock JM, Edwards RJ, Carey PD, Rose RJ (2000) Geographical separation of two Ulex species at three spatial scales: Does competition limit species’ ranges? Ecography 23:257–271.*

*Araujo et al 2014. The importance of biotic interactions in species distribution models: A test of the Eltonian noise hypothesis using parrots*

-claims that adding in the biotic factors improves it for all birds, but much less than that were significantly different, and a few were at a random intermediate spatial scale that doesn’t make much sense. Claims to be evidence against ENH, but it’s weak I think.

-4 scales (1km-29km), found little effect of scale

**OTHER RELEVENT PAPERS**

*Araujo and Rozenfeld 2014. The geographic scaling of biotic interactions*

-simulation study. Found that positive biotic interactions (mutualism, commensalism) manifested across scales, but that negative interactions (competition, ammensalism) were only visible at smaller scales. Consumer-resource (+/-) depended on how strong the positive effects were

*Yackulic 2017. Competitive exclusion over broad spatial extents is a slow process: evidence and implications for species distribution modeling*

-good review of evidence, but focused on competition rather than

\*\*Evidence for limited role of competition at broad spatial extents is mostly indirect

-correlative models with reasonable predictive accuracy

-species range limits being associated with seasonal isotherms

-range shifts matching climate shifts

-lack of recent invaders driving range losses at large spatial scales

\*\*Evidence that competition is relevant over broad spatial extents

-theoretical studies showing dispersal patterns influence whether competitors co-exist regionally

-studies near range edges. Reciprocal experiments (transplants + removal) paired with evidence of dispersal across range limits to address concerns about recent speciation or “autoecological differences”???

-paleoecological evidence that arrival of new competitors coincides with resident range shifts and extinctions (could habitat change drive both though?)

🡪 my observation is that there are also separate lines of evidence where papers try to show that one of the hypotheses is wrong rather than trying to show that one of them is right

\*\*Speed of process – process of competitive exclusion is likely to be slow (at start because of resistance, at end because of persistence in marginal habitats). Highlights that colonization rates are important.

-predation may be faster

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Presumably the answer is that climate is more important for some species but not for other species

Question is when is it important and how much does it matter?

Is there anything different about my dataset that would lend itself to answering a particular question relevant to this debate?

-a suite of related species sharing a similar environment

-pseudoexperiment/ natural experiment – would need to match conditions at different places

-look for papers that assess how correlations change with spatial scale – scale of effect

Check out *Yackulic et al 2015. To predict the niche, model colonization and extinction*

SESAM framework to integrate different drivers of distribution (Guuisan and Rahbek et al. 2011)

D’Amen et al 2015 – test of SESAM framework. They found that stacked SDMs didn’t over predict richness in most cases, unlike some other studies. SESAM useful in these cases for improving predictions of species composition

-could potentially be explained by whether or not bionomic/resource based predictors are used (in this case, NDVI and distance to forest)

Bennetsen et al. 2016. Species distribution models grounded in ecological theory for decision support in river management

Schmitt et al 2017. SSDM R package. Paper describes r package that produces various iteration of ssdms, including SESAM

Other papers testing SESAM framework

<https://pubag.nal.usda.gov/catalog/5799030>

-argued it didn’t work well because MEM part wasn’t good, found SSDM better, suggest due to abiotic factors being most important in producing richness patters

<https://onlinelibrary.wiley.com/doi/pdf/10.1111/jbi.12485>

-found improvement of predictions of community composition

<https://onlinelibrary.wiley.com/doi/pdf/10.1111/ecog.02990>

-used to predict future values of CTI (community thermal index?)

<https://www.sciencedirect.com/science/article/pii/S0304380018303600>

Febbraro et al. 2018. Using macroecological constraints on spatial biodiversity predictions under climate change: the modelling method matters.

-compared results of ssdm and sesam. Results suggested that ssdm predicted present richness better than sesam. However, both had opposite predictions if used for future scenarios (increased vs decreased diversity)

Hierarchical models:

Pearson, R. G. et al. 2004. Modelling species distributions in Britain: a hierarchical integration of climate and land-cover data. – Ecography 3: 285–298.

Time lags in environmental associations

How well has hindcasting worked? What areas are strong/weak?

MODEL SPECIFICITY VS GENERALITY / INFERENCE VS PREDICTION

We can distinguish three main objectives for SDMs:

(a) inference and explanation, (b) mapping and interpolation, and (c) forecast and transfer.

-How would they be developed differently? What am I trying to do?

1. –parameter estimates and their associated uncertainties
2. ?
3. –minimize test error – most correct predictions

<https://www.datascienceblog.net/post/commentary/inference-vs-prediction/>

<https://www.stat.berkeley.edu/~aldous/157/Papers/shmueli.pdf>

Elith and Leathwick 2009. Species Distribution Models: Ecological Explanation and Prediction Across Space and Time

<https://pdfs.semanticscholar.org/0bde/9d203c6035b107fe46f9c58e7530f87af9f7.pdf>

A focus on prediction rather than explanation has implications for the way that models are fitted and evaluated. Models for prediction need to balance specific fit to the training data against the generality that enables reliable prediction to new cases. Information criteria such as AIC (Akaike’s Information Criterion) address this balance by trading off explained variation against model complexity. Alternatively, data mining and machine learning methods use cross-validation or related methods to test model performance on held out data, both within the model-fitting process, and for model evaluation (Hastie et al. 2009). We anticipate expanding interest in machine learning methods for prediction. The special case of extrapolation needs more attention, so that robust model fitting and testing methods can be developed.

----idea based on p684 box: could you make SDMs where the assumption is disequilibrium? Quantify the disequilibrium somehow?

<http://depts.washington.edu/oldenlab/wordpress/wp-content/uploads/2013/03/MethodsEE_2012.pdf>

Wengre and Olden 2012. Assessing transferability of ecological models: an underappreciated aspect of statistical validation

-non randomly grouped cross-validation

Path analysis and Structural Equation Modelling

Joseph, M. B., Preston, D. L., & Johnson, P. T. (2016). Integrating occupancy models and structural equation models to understand species occurrence. *Ecology*.

-example of modelling approach I could hypothetically use. Depends on if I use the occupancy part or not?

-way of brining biological mechanisms into species distribution modelling, which is one of their main critiques

-causal model of species occurrence that explicitly accounts for non-detection

-latent variables are processes of interest, indicator variables are observed measurements that relate to the latent variables

-faster to use rstan that JAGS or BUGS

da Cunha, H. F., Ferreira, É. D., Tessarolo, G., & Nabout, J. C. (2018). Host plant distributions and climate interact to affect the predicted geographic distribution of a Neotropical termite. *Biotropica*, *50*(4), 625-632.

-similar idea to what Paul and I talked about as a way of doing my analysis, but simpler – just abiotic and biotic

-how is the variance partitioning part different?

Meineri, E., Dahlberg, C. J., & Hylander, K. (2015). Using Gaussian Bayesian Networks to disentangle direct and indirect associations between landscape physiography, environmental variables and species distribution. *Ecological Modelling*, *313*, 127-136.

-Bayesian version

Sanz‐Pérez, A., Giralt, D., Robleño, I., Bota, G., Milleret, C., Mañosa, S., & Sardà‐Palomera, F. (2019). Fallow management increases habitat suitability for endangered steppe bird species through changes in vegetation structure. *Journal of Applied Ecology*, *56*(9), 2166-2175.

-similar approach to what I’m imagining, but not applied in a predictive way