**Week 2 – Local Adaptation (conceptual)**

**17 Groups – 136+ participants (2 groups did not report counts)**

**What are the implications for how we individually define local adaptation on how we study it and what we think about the processes that drive it?**

**Penn State:**

* Local adaptation is on level of demes, however many foundation fauna (grasses, corals) produce extensively via asexual reproduction whereby a particular multi-locus genotype becomes locally dominant. This makes this genet particularly fit in this location and we would want to consider that local adaptation. In general, population models count individuals which can be misleading for colonial organisms and species where organismal sizes vary over a large range.
* When observing clines in gene frequency, the challenge is to understand the forces that generate the pattern. If migration is limited than differentiation in spaces is due to drift, but if there is differentiation in space despite strong gene flow it would be a strong indicator of spatially varying selection.
* Some of the most interesting case entail species that are able to maintain physiological rates across huge environmental gradients – here a non-difference in phenotypes might mask a large difference in genotypes
* Lack of theoretical treatments of the evolutionary dynamics in general and local adaptation in particular between hosts and mutualists rather than hosts and parasites.

**Florida State:**

* Pattern of local adaptation does not always tell us about the process or spatial scale of local adaptation (acknowledged in the paper), and that patterns of GxE for fitness, including its spatial structure, are equally interesting because of the different processes that cause it. The Blanquart et al. 2013 metric is compelling for quantifying and comparing local adaptation as a property of multiple local populations across multiple environments. The onus then is on empiricists to choose demes carefully and to interpret the metric with respect to why demes were selected and how they were sampled, especially in terms of divergent phenotypes/genotypes, and the strength of divergent selection and gene flow.

**Rutgers:**

* Discussed how local adaptation is defined as both a pattern and as a process and how this is often confusing. As a process, what seems to be important is the relative strength of gene flow vs. selection. In cases of extensive gene flow but strong enough selection to result in balanced polymorphisms, should we call this local adaptation? As a pattern, yes. As a process, no.
* Local adaptation is difficult to measure and study because nature is not in equilibrium, and that the demographics and history of natural populations matter. It is also important to have some knowledge of the spatial extent of your species in order to be able to define a “deme”.
* Spent time going over theory behind why few loci of large effect (vs many loci of small effect) may promote local adaptation.
* Briefly talked about how local adaptation in the ocean may be different from that on land. Besides the high potential for dispersal in the ocean, assortative mating may be more important in the ocean than currently recognized.

**Hal-Dames Rule:**

* Three definitions were 1) Home vs. Away: local adaptation is recognized by better performance (fitness) in home environments compared to other environments (comparison across location). 2) Local vs. Foreign: defined as home genotypes performing better than infiltrating genotypes (comparison within location). 3) Sympatry vs. allopatry: at metapopulation scale, performance is better on average in home locations than away locations after habitat and genetic quality effects are removed (comparing average performances).
* Comparisons are helpful descriptions of systems, but utility depends on questions being asked. Local adaptation could determine which species persist in a changing climate. So we might ask if species X show local adaptation? In this question, sympatric vs. allopatric is best. Consider performance of species as whole for local adaptation. For questions about potential of mal-adaptation, potentially in the context of range expansion, we suggest using local vs. foreign definition. LvF seems to be more about the maladaptiveness of invading genotypes more so than local adaptation. For questions about specific sub-populations that have economic or conservation value, we suggest Home vs. Away approach, though it confounds habitat quality and local adaptation.
* For many of these definitions, there are logistical issues to consider. Maternal effects can be confounding, which can be tested in the lab. Constrains local adaptation questions to focus on short-lived or fast-reproducing species that can be reared in a lab.
* None of these definitions appear to incorporate the effects of population size, which is particularly important at the margins of species range and likely also influences local adaptation.

**Nicholls State:**

* Common garden experiments may replace transplants when working with animals, but does not always accurately represent what happens in natural systems.
* The scale of local was the most important aspect of the definition. May not be appropriate to decide on one definition to fit all study types but maybe more appropriate to discuss scale in manuscripts.
* Plasticity and local adaptation are not mutually exclusive. Plasticity can be a trait that becomes heritable and, especially in a stochastic environment, may actually be selected for as the fittest condition.
* Issues of local adaptation specific to Louisiana were discussed: Adaptation of fish and crayfish to hypoxic conditions, salt tolerant cypress trees, black mangroves along northern range edge, etc.

**UMass Amherst:**

* Considered local adaptation in terms of metapopulation. Both papers refer to local adaptation as a trait of a metapopulation, because in order for one deme to be locally adapted, it has to be compared to another deme. Therefore, the metapopulation itself has to be locally adapted. This seems to be slightly new to this group, since they had been thinking of local adaptation on the deme-level scale.
* A metapopulation is locally adapted when demes experience natural selection based on differences in environmental conditions, such that individuals in a specific deme experience higher fitness in their home environment.
* Kawecki et al. concluded the local vs. foreign definition is the correct one to use and this group agrees, because adaptation to anything requires present genotypes within a population or deme. Also discussed amount of genetic variation needed for local adaptation to occur. Seems there is a slim margin- just enough for beneficial genotypes to be present but not enough that these genotypes get drowned out by more generalized genotypes.
* Test for higher fitness is very important to the study of local adaptation. Paper gives three methods to evaluate fitness: 1) looking at competition between genotypes from different populations, 2) measuring population growth rate, 3) measurement of trait performance. Applied each of these to their own systems, found it useful in thinking about local adaptation in own systems. Survival could be tested for #1, #2 could possibly be tested using mark-recapture (but difficult to think of), #3 was most obvious such as growth rates, fecundity, etc.

**UGA/UNH:**

* Best way to measure local adaptation is habitat and organism specific. Cleared up debate important distinctions in the model given habitat variability in quality as well as metrics, and between populations in terms of “adapted” versus plasticity etc. With fitness costs to plasticity and genomic trade-offs being rampant, discussion centered around what systems were actually seeing local adaptation versus environmental filtering of immense amounts of genotypic diversity – thus the benefits of being marine in the Steele et al paper are that an organism can disperse huge quantities of cheap larvae and they will end up matching environmental heterogeneity with genetic heterogeneity – which is distinct from local adaptation and falls more into the microbe/fungal “everything is everywhere and the environment select” adage. Spent time talking about “reproductive waste” and that local adaptation may be persistent as a pattern but not through maintaining identity by descent rather than by fortune.

**Washington State:**

* This group is diverse, and had diverse perspectives of selective drivers and traits. For example, local-foreign evaluation is necessary for confirming local adaptation, since focal population may have similar fitness home and away, but other populations may have extremely low fitness in the local environment.
* Could it still be called local adaptation if your focal population had lower fitness overall (in context of foreign populations) but had highest fitness in home environment? Considering traits that are expressed on a gradient (or a more dynamic fitness landscape) everything becomes more blurry. Does it matter whether you are better than everyone else in your environment, or just that you do best in your own environment?
* Papers did not directly consider was the impacts of competition on relative fitness – when we import populations into a focal population’s environment, are we considering the effects of their interactions when evaluating fitness?
* Discussed assumption of branching phenotype and genotype and how we evaluate local adaptation. Have to be careful about how we look at phenotype and whether we actually know the underlying genetic drivers. Strictly speaking, local adaptation is on the genetic level.
* Discuss how individual definitions of phenomena often depend on how we obtain funding, and for some, a lack of clarity in field-wide definitions can lead to questionable ethics in grant language use. Therefore, we agree that defining local adaptation, at least within this group – can benefit our efforts at large to arrive on a field-wide consensus.

**Virtual Group:**

* Generally agreed that local-foreign and sympatric and allopatric definitions seemed most useful. N=1 sample size seemed not ideal, however N=1 could refer to single plankton culture or larval culture and not the growth of one larva.

**Louisiana State:**

* Questions are more complicated than a simple, “this is the best definition.” Discussed that definition used depends on question being asked, number of demes/habitats being examined, even stage of experiment (exploratory vs. secondary). Not prudent to pigeon-hole into one definition.
* In every scenario, could think of home vs. away as the least useful definition of local adaptation because it does not account for either genotypic differences or habitat suitability. Also determined that local vs. foreign model is most useful when you have a few demes. When you have few demes, the use of sympatric vs. allopatric unnecessarily hides the variation. Sympatric vs. allopatric model might be useful if you are examining many demes, but in general, the sheer experimental effort required to test local adaptation thoroughly with more than 4 demes/habitats is uncommon. Therefore, why not use local vs. foreign.
* Sketch 3-deme example that found useful in describing why it is easier to show local adaptation via a graph rather than a quantitative value. See example and accompanying text (writing stuff won’t help).
* Science community seems to be relying heavily on sequencing alone as a method for determining local adaptation. Can we truly use sequencing with no transplant to show local adaptation? Does difference in genotype really matter if it doesn’t correspond to increase in fitness?
* I the selection occurs at the larval stage, long before settlement, how does this impact our definition of and methods for studying local adaptation? If you cannot use transplant experiments on adults, and larval phases are often still a black box (not much known), what options are there?

**UC Santa Barbara:**

* Myriad of implications for inconsistent definitions of local adaptation in larger ecological/evolutionary framework (an impediment of meta-analyses across systems), determining generalized patterns of species adaptive capacity to climate change hinges on a unified definition of local adaptation. Local adaptation is important for RCN-ECU because it may allow for more resilient genotypes to persist under changing ocean conditions; demes harboring these resilient genotypes may then “seed” or rescue other populations in the future. Clearly defining local adaptation has salient management/conservation implications.
* Kawecki et al. reserved the term local adaptation for “patterns and processes observed across local populations of the same species connected, at least potentially, by dispersal and gene flow.” Want to clarify that local adaptation could occur within species connected by dispersal and/or gene flow. For example, sea urchin ranges in western coast. Dispersal ranges don’t overlap, but there is gene flow via intermediate populations.
* Appreciating multiple models of local adaptation summarized by Kawecki and Ebert and Blanquart can improve studies of local adaptation in the context of metapopulation resilience. Application and comparison of multiple local adaptation models to a given system is necessary for 1) understanding complexity of dynamics occurring in multiple locally adapted demes, 2) using studies of local adaptation to leverage conservation efforts. For example, use of home-away or sympatric-allopatric models alone to explain variation in fitness related traits across demes could ignore variation in genetic quality across them. The finding that local adaptation is nominally occurring in a species is often concluded to be evidence of its adaptive potential to environmental change. However, may not be true if a majority of demes exhibit poor genetic quality relative to a few demes that exhibit heightened fitness within their local habitat. In this case, measuring gene flow from high quality demes to low quality ones would be necessary for understanding the resilience of a metapopulation to environmental change.
* Tying local adaptation back into our discussion of eco-evolutionary processes in marine vs. terrestrial systems, we discussed how their patterns and impacts of local adaptation may vary. Wider dispersal neighborhoods and higher gene flow among marine populations may reduce the frequency of locally adapted demes. At the same time, a locally adapted deme of high genetic quality is likely to be of greater benefit to an entire metapopulations as this deme may have a wide dispersal neighborhood, facilitating the transmission of resilient genes that are capable of rescuing species. Is it possible that terrestrial systems have more frequent but weaker instances of beneficial gene flow from “rescuing” demes, while marine systems have less frequent but stronger instances of beneficial gene flow from rescuing demes?

**Northeastern:**

* Many systems do not allow for reciprocal transplant experiments. Limited to evaluating local adaptation using some combo of common garden experiments or even GxE studies that correlate fitness associated traits with environmental variables. These studies are often much more feasible and, although they may not directly measure local adaptation, give initial evidence towards demes being adapted to certain conditions.
* Also think it is important to remember that GxE interaction for FITNESS is key to defining local adaptation. For example, GxE interaction for trait such as growth, but the population may still be locally adapted because they would have higher fitness in sympatry than allopatry. In addition, many studies do not directly measure fitness and only measure traits that researchers believe to be associated with fitness. May not directly measure local adaptation, this work gives important insights for identifying populations harboring traits that correlate with certain environments. These studies become even more crucial when identifying the adaptive potential of a population to withstand future environmental conditions under climate change.
* Two limitations: Blanquart paper recommends measuring more demes than individuals with the highest power coming from one individual per deme. Again, difficult to measure multiple populations and studies often can focus on a few. Also felt that one individual would bias any results about local adaptation due to that individual not representing the deme as a whole.

**UC Davis:**

* Two main sets of definitions for local adaptation differ in scale at which they are quantified. Local vs. foreign and Home vs away define LA for individual populations while Sympatric vs. allopatric is averaged across meta-population. Which definition depends on what sort of question we are asking.
* What is important in climate change is species survival or extinction. Important when we decide what definition to use since sympatric/allopatric looks at metapopulation while LF and HA look at individual populations. Local adaptation may increase diversity at metapopulation level even if local populations might go extinct during the process. The species as a whole can be repopulated by individual deme/population. However, LF and HA might be more important if we were to decide on where to build marine protected area. Setting one or two definitions of local adaptation will help move the field forward by making it easier to look for broad patterns and conduct syntheses and meta-analyses.
* There are different implications whether you look at local adaptation involving single or multiple genes/traits. Polygenic traits might be subject to recombination and their expression might depend on their placement in the genome (e.g., linkage to other genes). This can impact the level of local adaptation and tradeoffs due to linked genes subject to opposing selection. We find it important to combine sequencing with experimental setups.
* Post-settlement mortality is important and it could drive patterns that appear to be local adaptation. Explicitly accounting for post-settlement mortality would be crucial for measuring LA rather than other processes like environmental filtering.
* We decided that dispersal was an important feature to study regarding LA. It seems that a dispersal kernel (harkening week 1) of a given species needs to be defined before proceeding. In the sea, this kernel can have very long tails. In contrast, the habitat might vary at a much finer scale. Does this still lead to local adaptation? Or will individuals just move instead of adapt. In panmixed meta-population with a lot of gene flow and a large dispersal kernel, you can move through different habitats without microadaptation. Hence, we might find a mix of genotypes that is conserved across a mosaic of habitats.
* What is a population/deme? Could not find consensus of one definition in the ocean. In theory, populations are units that show higher levels of gene flow within than between. However, where do we set the cut of? Can we split large demes into smaller demes based on location? Or would we lump all demes into one that show the same sign of local adaptation? Are populations in the ocean more of a continuum than distinct parts?

**Matt Hare:**

* Blanqart paper only varied spatial heterogeneity but marine systems have a lot of temporal variability. How might that change the results of the paper? Fluctuating environments may make local adaptation weaker and lower power to detect LA.
* Struck by metapopulation perspective, LA is not a property of a single population, but rather of a metapopulation where multiple environments and populations are sampled. Understands general sentiment, but wouldn’t we expect LA to be stronger in some places than others? If we are interested in that gradient or patchiness in evolutionary capacity or in strength of selection, then it would not be desirable to treat the metapopulation as a whole and test for local adaptation on average. Thus, agrees that working definition will depend on particular objectives, but perhaps experimental results can be presented in such a way as to allow later analysis/synthesis with different objectives.
* Greatest power with one individual hard to swallow. For one, density dependence of fitness is likely to be common whereby a genotype will have different fitness if alone vs. with others, all else being equal. Do simulations reflect the enormous intra-population variation so often occurring within marine populations. To the extent that genotypic diversity elevates mean population fitness because of microspatial heterogeneity and microspatial GxE, the simple ways that environments were simulated could have led to a result that would not have much practical relevance.
* Spatial scales with high fecundity and broad dispersal have a lot of selection going each generation at small spatial scales relative to average dispersal distance (match-mismatch, balanced polymorphism). This is not classical LA that is not progressive and multigenerational but increases mean population fitness all the same. As others have noted this dynamic would generate deme differences that potentially confound and amplify patterns consistent with LA depending on the life stage sampled. Is it important to include adaptation from within-generation selection into our definition of local adaptation? Or control for it? Or parse it out? Thinks yes if we want to understand how processes affect patterns.
* We should stay anchored to motivation for studying local adaptation under increasingly rapid environmental change. We need to understand processes and mechanisms that influence the capacity for adaptive response by a population. Severe experimental constraints exist, but vital rates and population growth are what matters in eco-evolutionary dynamics and this emphasizes the need to study components of fitness across life cycle.

**MSC:**

* Where we look for LA in the first place depends in large part on individual definitions of local adaptation, which can make it difficult to make comparisons or general patterns. We raised several issues during course of discussion including:
* Which traits do we measure, emphasizing importance of vital rates and components of fitness, but also recognizing that bigger does not always mean better.
* How definitions of LA may vary across life history stages and/or entire life cycle (high gene flow but strong limits on post-settlement establishment)
* The difficulty in assessing connectivity (including dispersal and actual vs. potential gene flow) between populations in marine systems and how this may affect predictions and interpretations given that restricted gene flow is expected
* The role of abiotic vs. biotic factors in LA. Biotic is not often couched as LA, the way reciprocal transplant experiments are done may minimize or eliminate effects of the biotic environment. Biotic interactions may result in more temporally variable selection, which may require consequent changes in dispersal and gene flow to detect LA

**Cal State Monterey Bay:**

* Discussed merits of studying traits vs. fitness and common garden vs. reciprocal transplant experiments. Some definitions of LA were difficult to assess. There was nostalgic affinity for home vs. away definition, though shortcomings were recognized. Reflected overall tension in group about the merits of theoretical consideration, but the challenges in assessing them in marine systems.
* Scale not a big point of concern as most agreed that LA would be variable depending on scale and system and question people were asking.
* Temporal variation and its possible effect on local adaptation was discussed. Generally favored the sympatry-allopatry definition based on it being more explicit as a model, but in hindsight, could have spent more time debating whether it was sufficient than just the best of the three. If temporal flux could be encompassed into either habitat or deme effects, it might not be that big of a deal. There are likely cases in which the assessment of plasticity evolving as a response to temporal fluctuation could be explored as another means of further isolating the effect of local adaptation.

**Cornell:**

* Most agreed that it is more intuitive and meaningful to think about whether specific populations, rather than every single deme within a meta population, is adapted to local conditions. Seems likely that for a species distributed over a vast range of environmental conditions, we might expect LA in the extreme habitat conditions, but not necessarily in more intermediate ones. If strictly applying SA concept, might in such a case conclude that the species does not show local adaptation, which would be misleading.
* Questioned general value of knowing whether species shows LA or not. Fitness discussed in theoretical terms, while of course the practical reality is that fitness is hard to measure. Even if we could measure fitness perfectly, how much insight would we gain from knowing that a species shows LA if we don’t know the particular mechanisms or traits through which this local adaptation is conferred?
* It is important to study putative fitness traits, but also gain an understanding of what different traits and tradeoffs are involved in the adaptation and how each of these traits interact to influence fitness.
* We can use insights about LA to predict responses to climate change and other rapid environmental shifts. Seems that LA within a species could both hinder and promote adaptive responses. If populations are closely adapted to current local environment, they may not be able to respond quickly enough to change. In that sense, a really resilient generalist population may fare much better (LA could be disadvantageous). Conversely, having a diverse set of populations pre-adapted to many different environmental conditions could also seed rapid adaption in a changing environment, or if the species is mobile, can facilitate spatial re-organization of genotype-environment matches.
* Provoked by suggestion in Blanqart to do single individuals. Beyond obvious logistical challenges, discussion pros and cons of design. None could think of a study that used this approach.

**What definition of local adaptation should we (the RCN-ECS) network use?**

**Penn State:**

* Using mathematical notation, HA and LF was an improvement over the first paper
* Recognize issues marine field has with measuring fitness and particularly agreed with reminder that bigger is not always better

**Florida State:**

* No consensus reached. Presence of dispersal between demes seems to always raise discussion and different perspectives on what is and is not local adaptation. For example, it is often noted that a balanced polymorphism, where there is high dispersal and where genetic differentiation is maintained by strong post-settlement selection against migrants acting each generation after dispersal, is not local adaptation, but could still give rise to a pattern of local adaptation.
* However, another perspective is that the sorting of genotypes after settlement still effectively reduces gene flow, and could still lead to the evolution of local adaptation if there is enough local retention for persistence and subsequent build up of locally adapted alleles. The proportion of recruits that are immigrants vs. local origin at the scale being studied, seems relevant.
* Recommend Conover et al. for when transplant experiments are not feasible.

**Rutgers:**

* Local adaptation is challenging to define because it depends on your system and how local is local. Our working definition has three criteria: 1) phenotype needs to be heritable, 2) phenotype needs to influence fitness, 3) GxE interaction within habitat range that is possible from dispersal over multiple generations. Many processes could result in patterns of local adaptation.

**Hal-Dames Rule:**

* Generally, for synthesizing data, the best way to ascertain species level adaptation effects was to utilize the approach laid out by Blanquart et al. isolating local adaptation effects from genetic or habitat quality effects. Orthogonal reciprocal transplant studies can be turned into allopatric vs. sympatric comparisons, and we can potentially combine studies of different, putatively connected populations to parse together a meta-population to ask broad questions if data within a study is sparse.

**Nicholls State:**

* Defining terms narrowly may be a hindrance to good science. Design of local adaptation studies may vary drastically when the environment varies drastically (coastal CA vs. coastal LA).

**Washington State:**

* Long discussion of metaphors in science. Big umbrella terms are metaphors because they are used by a wide variety of people for different reasons, making our work more connective and approachable (theoretically). When we try to define metaphors, however, groups of people separate out with different definitions and metaphor no longer holds same strength across field. Group did not agree on whether metaphors should be strictly defined or left open, as long as they are accompanied by definitions.
* To make a definition, have to realize it is more important to exclude than include things. To do this, we have to agree on whether local adaptation is a property of the metapopulation or the deme. Is something locally adapted or is local adaptation happening? What is our evolutionary unit? Who is selection acting upon? We would argue that selection is acting upon? We would argue that selection is acting up the population level in our definition, it has to be for W between different populations.
* Why would anyone care about the metapopulation? We disagree that metapopulation is a part of the definition of local adaptation. We study local adaptation in the context of demes and focal populations, what happens to other populations is somewhat irrelevant. We still need perspectives from the home-away and local foreign perspectives, but local adaptation as a property of the metapopulation is not necessarily relevant to focal populations that have lower fitness in their own and other habitats.
* Take home perspective is important. Sympatric-allopatric perspective is just rebranding of home-away but just controlling for habitat quality. We care about story of one population, which means that home-away is the best metric. However, need to know the context of other habitat quality, and therefore local-foreign is needed to be able to say a population is better in their home environment and others do in that same space.
* When you think you have a locally adapted population but don’t see a home vs. away differences because of limitations on measurements, we need extra inference from the local-foreign population.
* Argue for using more than one individual per population, which is obvious inclusion when you consider on the population instead of the metapopulation level.
* When measuring local adaptation, focus should be on repeatability of evolving those specific traits and think carefully about complex vs. mendelian traits.
* Thought process on defining local adaptation must be strict in considering which drivers of selection we consider, and how we incorporate (or not) potential interactions into the “habitat” variable.

**Virtual Group:**

* Emphasized importance of understanding local adaptation as process, not just a pattern. However, the definition will depend on the question and should account for: local adaptation in time (seasonal changes in phytoplankton), the role of post-settlement selection (LA isn’t happening if panmixia occurs in gametes/larvae every generation, but if only adults are sampled, could easily look like LA (pattern). The importance of genetic structure (though post-settlement selection can lead to genetic structure in sampled adults without LA). The importance of scale and patchiness of habitat (how do the definitions and practicalities of measuring LA change if you are considering patches vs. different ends of a cline)
* A flow chart might be a convenient way to summarize the best way to test for local adaptation given the particularities of the system at hand.
* How to test for LA? Discussed it can be unethical to do transplants if there will be gene flow into surrounding populations, particularly a concern for open systems. But, lab studies have obvious drawbacks discussed in readings. Also talked about role of molecular studies, which has changed a lot since 2004.

**Northeastern:**

* First thought to begin definition of local adaptation as needing genetic component but found in discussions that genetic component may not always be detectable, especially when many loci of small effect are responsible for a given phenotype and these may not be detectable by current statistical models. In addition, current literature around epigenetic shows epigenetic modifications do not change the underlying code but are heritable and potentially increases the fitness of offspring in a given environment. Therefore, if we cannot detect a genetic component to phenotypic differences when placed in different habitats can we not call that local adaptation?
* Rather discuss when home vs away or local vs foreign would be appropriate and/or useful ways of truly identifying local adaptation. Each definition is useful in its own right and can provide useful information. For example, the home vs. away comparison tells if deme is currently located in a habitat in which it displays highest fitness compared to other habitats. We could not conclude that a population is locally adapted in its “home environment” from this comparison. A deme may have highest fitness in its home habitat when comparing across habitats, but other allopatric demes may have higher fitness and be more adapted to that focal deme’s habitat. This comparison still gives important information about adaption in the focal deme and where it may survive and persist but may not always identify local adaptation.
* Local vs. foreign definition instead can tell us if the sympatric deme is more fit in the environment in which they are found when compared to all other allopatric demes. This can more often identify local adaptation because comparing a focal, sympatric deme to all other demes in the study and identifying the deme with the highest fitness. Again, able to think of scenarios which we would not detect local adaptation using this method, such as populations undergoing selection or historic bottlenecks.

**UC Davis:**

* We think one definition may not suffice. Since SA definition operates at the level of metapopulation and LF is best at the level of the deme, they can be used to address different questions depending on the scale of interest. Maybe best to calculate both metrics but rely on the definition that fits the study question. However, uses of the LF or HA should address their limitations (deme quality and habitat quality should be recorded/quantified).

**MSC:**

* There is value in considering multiple metrics of LA and thus found it difficult to choose one. SA lacks power to test a number of experimental designs that might provide valuable info on LA at population scale. Being able to make pairwise comparisons can be valuable and informative (as opposed to thinking only at a metapopulation scale). Similarly, being able to assess patterns at a population level is sometimes necessary as we seek to understand and predict the effects of climate change, but this isn’t possible using only the SA approach given the focus on average performance at the metapopulation scale. Additionally, SA approach doesn’t account for mortality, so how often this approach has been successfully applied in marine systems and how often mortality (and other realities of experimental manipulations) hindered applications of SA approach.

**Questions:**

It is important for RCN to come to consensus on language referring to the study of local adaptation.

* 22 Agree
* 0 Disagree

Local adaptation is not a property of a single population but a property of metapopulation.

* 17 Agree
* 0 Disagree

When studying local adaptation, the deme is the relevant unit of biological replication and more than 2 demes should be studied.

* 14 Agree
* 3 Question Mark
* Some discussion over what a deme is, but overall, none disagree.

A GxE interaction is a prerequisite for local adaptation.

* 23 Agree
* 0 Disagree

Local adaptation cannot be determined from a single population transplanted across multiple environments. Nor can it be determined by multiple populations grown in the same single environment/location.

* 17 Agree
* 1 Disagree
* One comment advising caution against using absolutist language or drawing lines in sand.

It is inappropriate to say “population/deme X is locally adapted to environment Y” because of the metapopulation context of local adaptation: it implies something about the fitness of other populations in that environment. Instead it would be more accurate to say, “population/deme X has evolved via natural selection to environment Y”

* 7 Agree
* 3 Disagree
* 5 Do not know
* 1 comment suggesting that it depends on why you want to know about population x.

We should be careful to use language that distinguishes between the extent of local adaptation of a metapopulation, the extent to which a deme has evolved (including processes of selection, mutation, drift, and gene flow) in response to local conditions and the extent to which that evolution is due to evolution by natural selection.

* 15 Agree
* 0 Disagree

The RCN should use the quantitative metric proposed and sympatric/allopatric statistical test by Blanquart et al to measure the extent of local adaptation of a metapopulation.

* 4 Agree
* 5 Disagree
* 6 Unsure

We need to come to a consensus on quantitative metrics that can be used to measure the extent to which a deme has adapted to local conditions.

* 22 Agree
* 0 Disagree

The RCN should use one of the three definitions proposed in the Blanquart paper: Quantitative definition 1 – a quantification of the proportion of spatial variation in mean fitness caused by adaptation to local conditions in a metapopulation. Quantitative definition 2 – the difference between fitness of populations in sympatry (eg transplanted back where they came from) and populations in allopatry (transplanted somewhere else). Quantitative definition 3 – the component of GxE interaction explained by sympatric vs. allopatric contrast.

* 6 Agree
* 2 express concerns that if we use this definition, previously published examples of local adaptation will no longer qualify as examples of local adaptation.

The definition of local adaptation that should be used is context dependent.

* 6 agree
* 6 disagree