

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTEGRATED DNA TECHNOLOGIES, INC.,
Petitioner,

v.

TECAN GENOMICS, INC.,
Patent Owner

Case IPR2025-00015
Case IPR2025-00016
U.S. Patent Nos. 10,036,012 and 10,876,108

DECLARATION OF ELI MEYER, PH.D.*

* This declaration is being filed as a substitute for EX2039, as authorized by the Board. *See* IPR2025-00015, Paper 39.

TABLE OF CONTENTS

I.	BACKGROUND AND QUALIFICATIONS	4
II.	THE STUDY IN MEYER FOCUSED ON SEQUENCING THE ENTIRE CORAL TRANSCRIPTOME IN ONE SEQUENCING RUN	7
III.	HOW WE OVERCAME CHALLENGES TO SEQUENCE AN ENTIRE TRANSCRIPTOME	10
A.	Overcoming Bias Towards Highly Abundant Transcripts	10
B.	Overcoming Bias Towards 3'-ends of Transcripts	11
C.	Overcoming Bias Towards Shorter Transcripts	12
D.	Avoiding Non-Productive Sequencing of Artificial Adaptors	12
E.	Avoiding “Blinding” the 454 sequencer with Poly-A Tails	14
IV.	OUR METHOD IN DETAIL	15
V.	OUR RESULTS.....	25
A.	Assembling a Full Larval Transcriptome of <i>Acropora millepora</i>	25
B.	Evaluating the 3'-end Bias.....	27
C.	SNP Validation	28
VI.	MISUNDERSTANDINGS CONCERNING OUR STUDY.....	29
A.	We Did Not Use the Modified Method in Additional File 4.....	29
B.	Our Methods Did Not Allow for the Selective Enrichment of Specific cDNA Sequences	30
C.	Our Data Does Not Show Target Enrichment.....	33
VII.	CONCLUSION	36

I, Eli Meyer, declare as follows:

1. I have been retained by Patent Owner, Tecan Genomics, Inc. (“Tecan”) to provide testimony in this *inter partes* review regarding my work with early NGS techniques. I understand that Dr. Mikhail Matz previously submitted a declaration at EX2039. I have read and considered the Declaration of Mikhail V. Matz, Ph.D., including all the documents cited therein. A copy of the Declaration of Mikhail V. Matz, Ph.D. that I reviewed is attached as **Exhibit B** to this declaration. I have independently verified the content and analyses that Dr. Matz included in his declaration, and I confirm that I have reached the same independent opinions on this matter. In doing so, I have relied on my own personal knowledge and information that is publicly accessible. My testimony only concerns my opinions and the public materials in the Meyer publication. Therefore, I hereby adopt the statements made in EX2039 with minor, non-substantive revisions, which are reflected in this declaration starting at Paragraph 15. My relevant background and experience are included below. I affirm that I have not spoken with Dr. Matz about my opinions or the substance of this declaration.

2. I am the first author of the research article *Sequencing and de novo analysis of a coral larval transcriptome using 454 GSFlx*, which I understand to be referred to as Meyer, Meyer 2009, or EX1006 in this proceeding. As the first author,

I contributed substantially to Meyer, including drafting the publication and participating in library preparation.

3. Tecan requested that I submit this declaration to aid the Patent Office in its review of Meyer.

4. I understand that there are two *inter partes* review proceedings concerning my work and that IDT relies on my work for its anticipation and obviousness arguments. I have not been asked to provide any opinions as to the ultimate issues of anticipation and obviousness that IDT has raised.

I. BACKGROUND AND QUALIFICATIONS

5. Over the past 27 years, I have studied and researched various topics in marine biology and genomics, including methods for PCR amplification, PCR suppression, and coral genomics.

6. I obtained my Ph.D. in Biology in 2006 from the University of Southern California in Los Angeles, CA. During my graduate studies and postdoctoral training, I researched and published on genomic methods for the study of marine invertebrates using cDNA normalization, PCR suppression, and PCR amplification. I conducted my postdoctoral studies at the University of Texas – Austin from 2007 to 2012, under the direction of Dr. Mikhail V. Matz and Dr. Thomas E. Juenger.

7. In 2012, I joined the faculty of Oregon State University as an Assistant Professor in the Integrative Biology department. In this role, I served as the principal

investigator for a genomics research laboratory. As the principal investigator, I oversaw the research conducted in the laboratory. During my academic career, I published 41 peer-reviewed papers using DNA sequencing to study non-model organisms like corals. My research has been referenced in the published works of others more than 5,800 times.

8. In 2019, I launched a startup business providing DNA testing services for the saltwater aquarium hobby and aquaculture industry. For this venture, I adapted DNA sequencing methods from my academic research to develop a commercially viable testing service. My company, AquaBiomics LLC, uses DNA sequencing to identify harmful or beneficial bacteria in the aquarium, along with the parasites that cause disease in aquarium fish. Operating this DNA testing service has been my full-time occupation since 2019.

9. I understand that one of my prior publications on sequencing and coral genomics, Meyer, is at issue in these proceedings. We conducted the study described in Meyer in 2008 and submitted it for publication on January 13, 2009. I was part of the team that developed these methods, and conducted most of the experiments and analysis. I also drafted the manuscript discussed here (Meyer). My postdoctoral advisor, Dr. Matz, under whose direction this work was conducted, also contributed substantially to the experiments and manuscript.

10. The study described in Meyer represented a collaboration between the Matz laboratory, the Center for Genomics and Bioinformatics at Indiana University, and James Cook University in Australia. Our laboratory prepared the sequencing library used in Meyer while researchers at James Cook University facilitated sample collection, and researchers at Indiana University sequenced the library with the 454 sequencer. EX1006.0017.

11. I drafted the manuscript, created the bioinformatics scripts that were used to evaluate the sequencing results, conducted the sequence analysis and annotation, and participated in sample collection and library preparation reported in Meyer. *Id.* Dr. Matz conceived of the overall study and library preparation methods described in Meyer. *Id.* Research assistant Galina Aglyamova helped prepare the cDNA sequencing library used in Meyer. *Id.* Another postdoctoral researcher, Shi Wang, analyzed single nucleotide polymorphisms (“SNPs”) in the sequencing data and validated the results. *Id.* I worked closely with all of them and had personal knowledge of their work and our disclosure of this work in Meyer.

12. A copy of my curriculum vitae, attached as **Exhibit A**, contains further details on my education, experience, publications, and the other qualifications allowing me to render an opinion in this matter.

13. I am being compensated my standard rate of \$250 per hour, plus expenses. My compensation is in no way dependent on the content of my testimony or upon the outcome of this proceeding.

14. I have not previously testified as an expert witness.

II. THE STUDY IN MEYER FOCUSED ON SEQUENCING THE ENTIRE CORAL TRANSCRIPTOME IN ONE SEQUENCING RUN

15. In 2008, the Matz lab focused on studying various species of coral and their role in sustaining marine ecosystems. We were interested in understanding the stress tolerance of coral and the interactions between coral and algae—both issues that were poorly understood at the time. This was important to us because it could help us better understand what impact climate change and other environmental stressors would have on marine ecosystems. By 2008, we recognized an urgent need to understand the potential for corals to adapt to climate change. *See* EX1006.0001-02.

16. As we reported in our publication, we felt that new methods were needed for “genomic-scale analysis of emerging model organisms that exemplify important biological questions but lack fully sequenced genomes.” *Id.*, .0001. We believed that NGS could be harnessed to “make possible the detailed studies of gene expression, genetic connectivity, and stress physiology required for addressing” the questions being investigated by my lab. *Id.*, .0002.

17. While a few studies had already used NGS technology to sequence the transcriptomes for organisms with already completed genomes, we observed a lack of methods for *de novo* assembly and analysis of transcriptomes without a reference genome sequence, which limited the study of emerging model organisms. *Id.* Even more, we noticed that NGS methods had not yet been applied to corals. *Id.* In fact, only a small set of sequencing reads were available for just three coral species. *Id.* Some studies had used Sanger sequencing to identify expressed sequence tags (short sequences that correspond to expressed genes) and partial genome sequences. *Id.* But no coral genome or transcriptome had been completely sequenced and assembled. *See id.*

18. We wanted to facilitate genomics studies in corals and other non-model systems through the use of NGS technologies given their increased throughput, which could expand the amount of known sequencing data. *Id.* NGS was not widespread at the time since it had only been commercially available for a few years. Moreover, in these early days of NGS, researchers had just begun to adapt the technology to their respective disciplines. At the time, the 454 pyrosequencer had been commercially available for about three years, and the Solexa Genome Analyzer (what would later be acquired by Illumina) had been available for about two years. The Ion Torrent sequencer would not be released for over another year.

19. Not only was NGS relatively new, but researchers were also concerned with the accuracy of the platforms available. While NGS made it possible to sequence considerably larger volumes of genetic material more efficiently, NGS suffered from a number of problems that resulted in lower quality sequencing reads than Sanger sequencing. These concerns were exacerbated when there was no existing reference genome since researchers had no way of comparing to see whether the sequencing reads were inaccurate.

20. Through Meyer, we wanted to demonstrate as a proof of concept that researchers could deep sequence entire transcriptomes of emerging model organisms in a single 454 sequencing run and rely on that sequencing data to *de novo* assemble entire transcriptomes. See EX1006.0002. Our improvements to existing methods focused on ways to improve sequencing read output and to assemble catalogs of genes from that output. *Id.* To demonstrate the effectiveness of our improvements, we applied these methods to sequence the larval transcriptome of the coral *Acropora millepora*. *Id.*

21. As we report in Meyer, we succeeded in sequencing the entire transcriptome. *Id.*, .0001. I believe this was one of the earliest instances in which a lab had succeeded in fully sequencing a transcriptome of a non-model organism with no prior genomic resources, using the 454 sequencing platform. Our study also succeeded in assembling and annotating the transcriptome of the *A. millepora*, which

provided critical insight into the genetic makeup of the coral species, furthering other coral research.

III. HOW WE OVERCAME CHALLENGES TO SEQUENCE AN ENTIRE TRANSCRIPTOME

22. The sequencing results reported in Meyer were generated with the 454 GS-Flx sequencing platform. EX1006.0001. Our primary goal in Meyer was to sequence the entire transcriptome. *See id.* This meant that our biggest challenge would be to *avoid the preferential sequencing of certain genes or transcript regions* and to ensure that the whole transcriptome was covered as evenly as possible. This required overcoming biases towards highly abundant transcripts, the 3' ends of transcripts, and shorter transcripts. The second challenge would be to avoid sequencing our own artificial adaptors so that we could maximize the output of actual new coral sequences. The third challenge would be to mitigate 454-specific optical artifacts stemming from the sequencing of the poly-A tails that are present at the 3'-end of every transcript.

A. Overcoming Bias Towards Highly Abundant Transcripts

23. Transcript abundances can vary by several orders of magnitude across genes. If such a sample were to be sequenced directly, we would have enormous sequencing coverage for a small number of genes producing highly abundant transcripts, while the rest of the transcriptome would get little or no coverage. To solve this problem, we applied the normalization procedure implemented in the

Evrogen Trimmer kit. *See* EX1006.0013; EX2081. This procedure equalizes the abundances of transcripts, reducing the difference in their relative representation from several orders of magnitude to just 2-3 fold, reducing the problem dramatically. In Meyer, we applied this normalization procedure after cDNA synthesis and before fragmentation. *Id.*

B. Overcoming Bias Towards 3'-ends of Transcripts

24. In the protocol for cDNA synthesis that we used in Meyer, the cDNA synthesis is initiated using an oligo-dT containing primer, which anneals to the poly-A tail present at the 3'-end of every protein-coding RNA. *Id.* This method of cDNA synthesis was introduced in the 1990s and has an important advantage of selecting against ribosomal RNA, which is of no interest to us but constituted over 90% of the sample.

25. The RNA molecule was then copied by the reverse transcriptase (RT) enzyme into cDNA, going from the 3' to 5' ends of the mRNA. Sometimes, the RT enzyme failed to copy the entire length of the RNA molecule. This was especially more likely to occur the longer the RNA molecule was because the RT enzyme would need to copy more nucleic acids. *See* EX1034.0004. This premature termination of the copying process could lead to over-representation of 3' regions since the copying process begins at the 3' end. *Id.* In these instances, the 5' end of the RNA molecule would be under-represented in the cDNA copies. *Id.* To avoid the 3' over-

representation (and 5' under-representation), we used the SMART cDNA amplification kit (Takara). EX1006.0013. This kit uses a “template-switching” method to amplify RNA molecules that have been copied in their entirety. As such, we were able to ensure that the cDNA copies contained the 5' and 3' ends as well as the nucleic acid sequences in between.

C. Overcoming Bias Towards Shorter Transcripts

26. Polymerase chain reaction (“PCR”) amplification has a well-known tendency to increase the representation of shorter molecules in a mixed sample (such as a transcriptome library), because shorter fragments are amplified more efficiently. *See* EX2081.0009. To combat this tendency during our library preparation procedure, we normalized and amplified the original cDNA library with primers annealing at both ends of each fragment (as per the SMART cDNA amplification protocol). EX1006.0013. We also used a low number of PCR cycles (15) to amplify the normalized library, which reduced the chance for PCR artifacts to accumulate. *Id.*

D. Avoiding Non-Productive Sequencing of Artificial Adaptors

27. If we were to simply take our normalized cDNA sample and use the standard 454 sequencing library preparation kit on it, as much as one-quarter of all reads would have been unusable, containing mostly or exclusively sequences of adaptors used during the library preparation. To avoid this, we developed the

sequencing library preparation scheme that avoids placing the read-initiating primer next to adaptor sequences. This scheme is outlined in Figure 1 below:

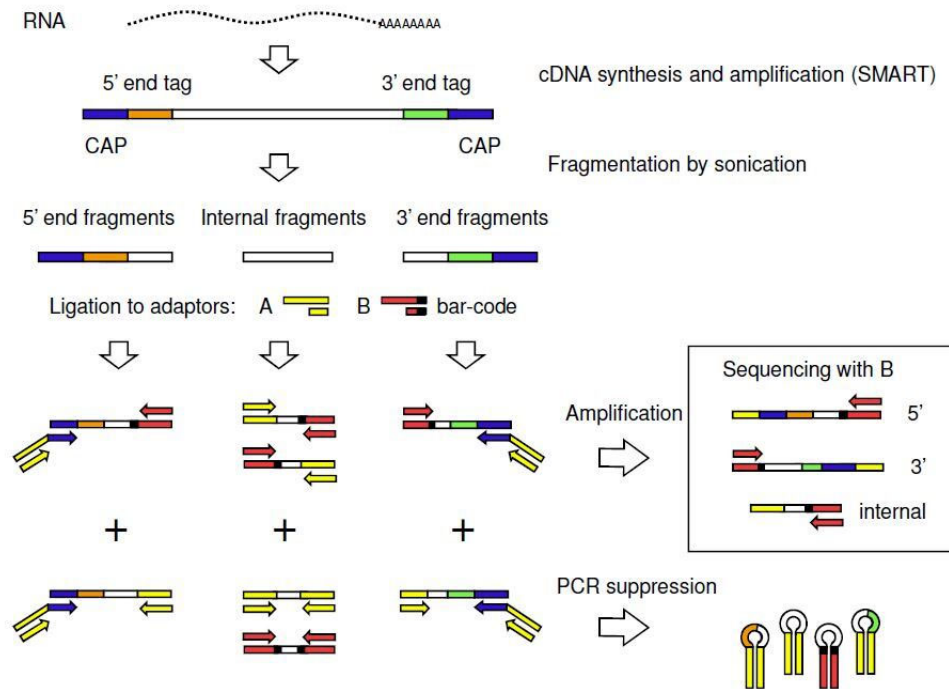


Figure 1
Diagram of cDNA synthesis and 454 library preparation procedures. Three fragment types are produced by sonication: 5', internal, and 3'. Ligation with the partially double-stranded adaptors A and B produces, for each fragment type, certain adaptor configurations that will be amplified (above the '+'), and others that will be suppressed (below the '+') during the subsequent amplification. The procedure preferentially amplifies constructs that are appropriate for 454 sequencing (shown inside box).

EX1006.0003. The read-initiating primer, shown as a red arrow in the figure, always points towards the white part of the DNA, which is the original coral transcript sequence, and is not located next to the adaptors. An additional feature of this scheme is the suppression of amplification for unsequenceable fragments flanked by the same primer on both ends (what we refer to as PCR suppression in Meyer). *Id.*

E. Avoiding “Blinding” the 454 sequencer with Poly-A Tails

28. The 454 sequencer used pyrosequencing by creating DNA complementary to the fragments to be sequenced. This process featured rounds of controlled nucleotide incorporation where the sequencing plate was washed with only one nucleotide species (e.g., A, T, G, C) for any given round. Each incorporation would emit light because of the pyrophosphate released during the reaction. Optical sensors in the 454 sequencer would detect these light emissions for each fragment being sequenced and generate graphs that could be used to identify sequences.

29. In a typical nucleotide sequence where the sequence is varied, a single nucleotide would be added to the complementary sequence, emitting a single signal pulse. However, when several bases of the same kind appear in a row (a homopolymer comprising, for example, sequences CCCC or AAAAAA), the addition of the homopolymer-forming nucleotide in that round results in multiple base incorporations, generating a brighter light signal. The brightness of this signal is used by the 454 instrument to infer how many bases are repeated within the homopolymer sequence.

30. This method can malfunction with the poly-A sequence found at the end of every protein-coding transcript. Assuming a typical library preparation protocol (such as the SMART cDNA amplification kit), the poly-A tail could be 30

bases long. Incorporation of that many nucleotides in the same 454 sequencing round would generate a far stronger burst of light than the 454 platform's sensors were equipped to handle. Such a burst would essentially blind the sensors, throwing off their calibration and leading the instrument to discard the whole read as well as reads in neighboring microwells, which could result in the failure of the whole sequencing run.

31. Even though we ensured that sequencing always starts from the actual coral transcript part (Figure 1), due to the randomness of fragmentation, the coral part can be short enough for the read to run into the adaptor sequence, including the poly-A/T stretch. Even though we used a shorter poly-T-primer than standard (with only 13 “T” bases in a row, *see* EX1006.0013), any sequencing of that region would have led to us having to discard the poly-A/T containing reads and nearby wells. To fix this, we introduced an additional modification: a “broken-T” primer, where we interrupted the T(13) homopolymer with a single “C” base in the middle. *Id.* We did this to avoid the “sensor-blinding” problem with the 454 sequencer.

IV. OUR METHOD IN DETAIL

32. There are two library preparation methods reported in Meyer: the method illustrated in Figure 1 and the method illustrated in Additional File 4. As we reported in the publication, we only used the method reported in Figure 1 to prepare the samples that were sequenced and reported in Meyer. EX1006.0002 (“A cDNA

sample was prepared from coral larvae as illustrated in Figure 1”). Unless otherwise specified, any references I make to the method reported in Meyer refer to the method reported in Figure 1.

33. The method incorporates the solutions outlined above and was used to prepare the mRNA transcripts for sequencing. Figure 1 is an accurate representation of cDNA synthesis and library preparation in the method.

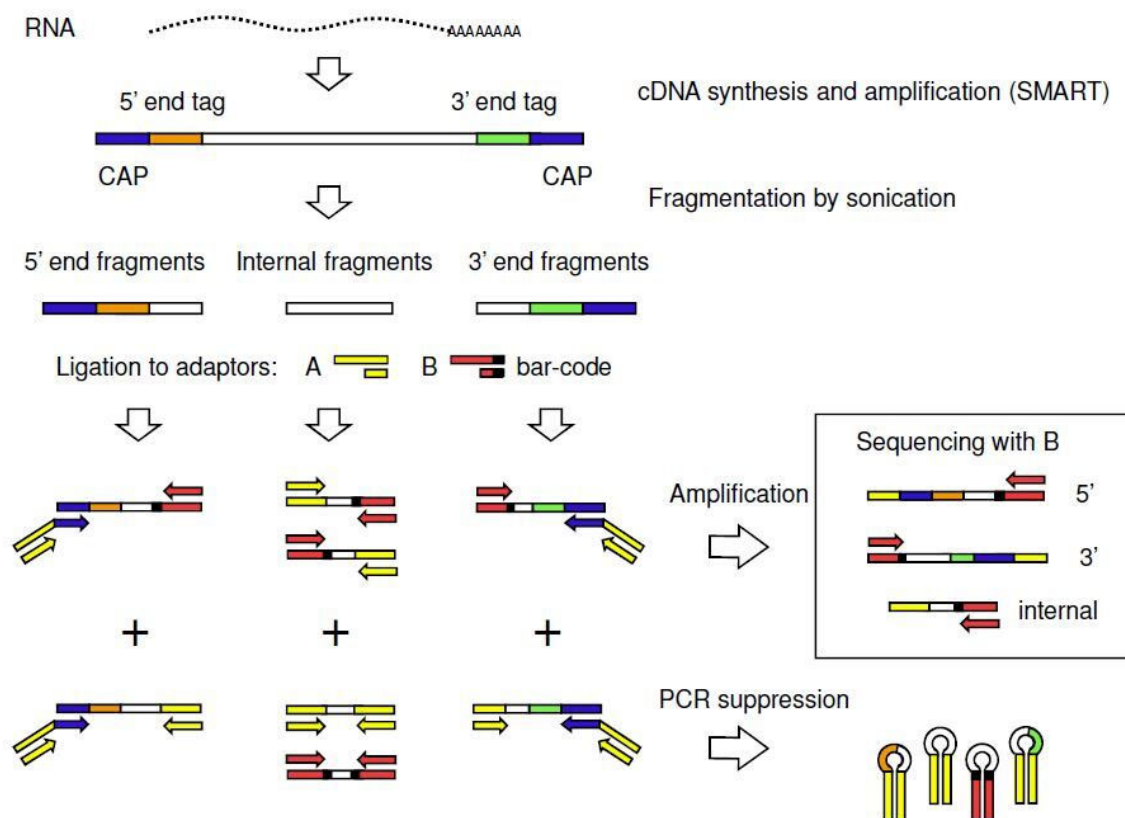


Figure 1
Diagram of cDNA synthesis and 454 library preparation procedures. Three fragment types are produced by sonication: 5', internal, and 3'. Ligation with the partially double-stranded adaptors A and B produces, for each fragment type, certain adaptor configurations that will be amplified (above the '+'), and others that will be suppressed (below the '+') during the subsequent amplification. The procedure preferentially amplifies constructs that are appropriate for 454 sequencing (shown inside box).

34. In our study, we extracted RNA from coral larvae using a standard extraction kit. *Id.*, .0012. We purified the extracted RNA through lithium chloride precipitation, which removes contaminating DNA and proteins. *Id.*, .0012-13. The precipitant was centrifuged and analyzed on a gel to ensure purity. *Id.*, .0021.

35. 454 sequencing required that the RNA be converted to cDNA before the nucleic acids could be sequenced. We used Clontech's SMART cDNA synthesis and amplification kit to reverse transcribe and amplify purified RNA. *Id.*, .0012. This was a standard procedure at the time. We also used this kit because it is designed to only amplify cDNAs that have been reverse-transcribed in their entirety, "preferentially enrich[ing] for full-length cDNAs." EX1034.0004.

36. We followed the manufacturer's instructions for cDNA synthesis, except that the primer used for the first strand of cDNA synthesis was customized to incorporate the broken chain T sequence. We did this "by the inclusion of an internal C to minimize the potential for 454 sequencing problems in [the] homopolymer stretch." EX1006.0013. The modified CAP primer with the broken chain is shown below.

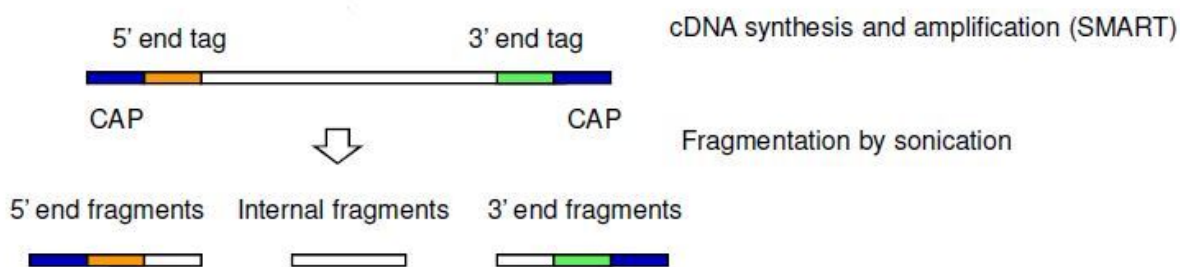
Cap-TRSA-CV (first strand cDNA synthesis primer):
5'- AAGCAGTGGTATCAACGCAGAGT CGCAGTCGGTACTTTTTCTTTTTV – 3'
("cap" primer sequence) ("broken chain" polyT)

Id., .0019.

37. The SMART protocol amplifies the cDNA strands by using the CAP primers. We followed the manufacturer's instructions and used PCR suppression to "preferentially amplify longer molecules and thus enrich for full-length transcripts." *Id.*, .0013. This preferential amplification was important because it counteracts the natural tendency of PCR to amplify shorter molecules over longer ones, which would have created a bias towards shorter transcripts. EX2081.0009. This entire process occurred before fragmentation. *See* EX1006.0013, .0021-23.

38. After we normalized and amplified the full-length cDNA strands, we fragmented them by sonication to produce short, random fragments appropriate for 454 sequencing. *Id.* We optimized this process to produce fragments that were roughly 300-400 nucleotides in length. *Id.*, .0013.

39. As depicted in Figure 1, fragmentation generated three types of fragments: (1) internal fragments that represented most of the regions of the mRNA transcripts; (2) 5' end fragments; and (3) 3' end fragments.



EX1006.0003. The above figure is a simplification of the process and does not reflect the ratio of fragment types. For every pair of end fragments, there were

several internal fragments. Altogether, these fragments represented the entire length of the cDNA strand. The end fragments retained the CAP primers at their termini (shown in blue above). The 5' and 3' end fragments contained slightly different CAP primers with the 3' end fragment CAP primer incorporating the broken chain T sequence (shown in green above).

40. We ligated pseudo-double-stranded adaptors that either contained the Primer A or Primer B sequence to polished cDNA fragments. *Id.*, .0013. These adaptors are illustrated below.

B+ adapter:
Long oligo: 5'-GCCTTGCCAGCCCGCTCAG ACGAGCGGCCA-3'
(B primer sequence) (suppression tag)
Short oligo: 5'-TGGCCGCTCGT-3'

A+ adapter:
Long oligo: 5'-GCCTCCCTCGCGCCATCAG CCGCGCAGGT-3'
(A primer sequence) (suppression tag)
Short oligo: 5'-ACCTGCGCGG-3'

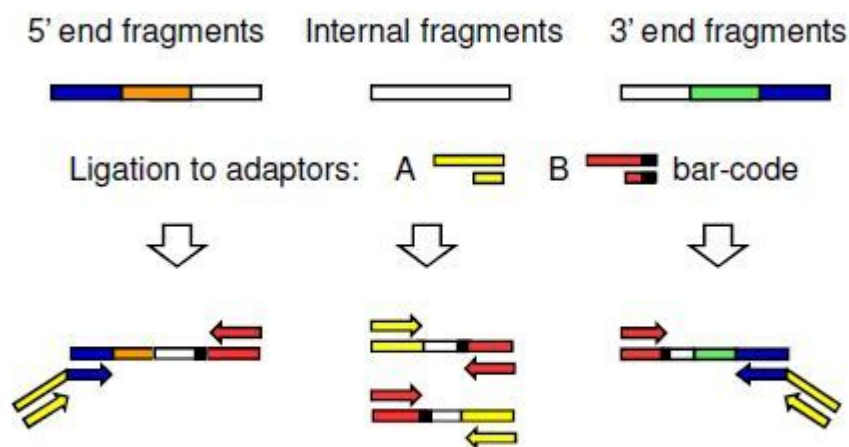
EX1006.0019. As reflected in the illustration, each adaptor contained suppression tags.

41. These adaptors were only ligated to the “new” 5' ends formed as a result of fragmentation/polishing. *Id.* Since the incorporated CAP primer used for cDNA amplification was present on the original ends of the cDNA strands and lacked 5' phosphates, the pseudo-double-stranded adaptors were not able to ligate to them. *Id.* At the initiation of PCR amplification (before the first DNA denaturation step), the

DNA polymerase in the reaction would fill in the primer binding sites on complementary strands.

42. We then annealed the universal primers A and B and a primer known as “A+CAP” to the fragments. *Id.*, .0013. The “A+CAP” primer was complementary to the CAP primer sequences and contained the Primer A sequence at one end of the primer. *Id.* The “A+CAP” primer was used to incorporate the “A+” sequence at each of the original cDNA termini. *Id.*, .0019. This was important because without it, the end fragments could not be attached to the 454 beads for sequencing.

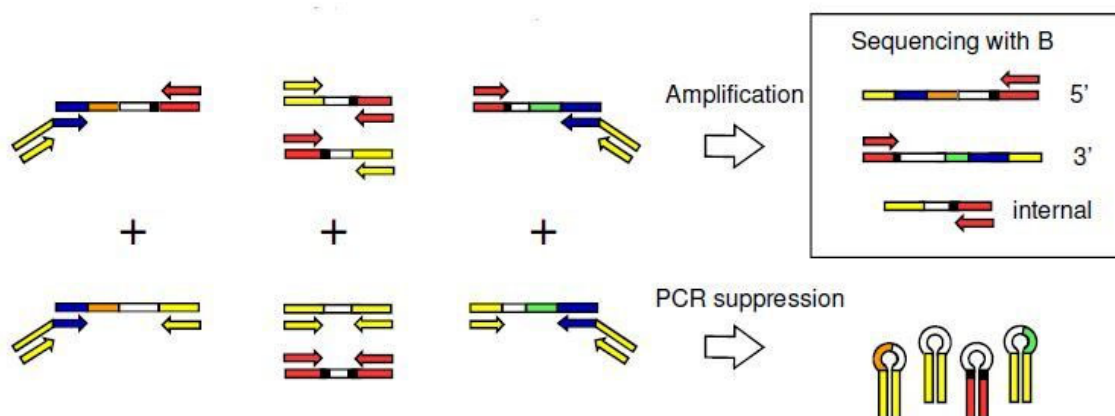
43. The A, B, and “A+CAP” primers were all added to the mixture after adaptor ligation and before annealing. *Id.*, .0013. The directed ligation of the pseudo-double-stranded adaptors and annealing steps are illustrated below.



Id., .0003. The CAP primers (blue) are attached to the two termini of the original cDNA strand. The pseudo-double-stranded adaptors ligate to the uncapped ends of the cDNA fragments (white). The “A+CAP” primers (blue arrows) anneal to the CAP primer sequences. The “A+CAP” primers contain the Primer A sequence (yellow) at their ends.

44. After the primers anneal to their corresponding sequences on the fragments, extension products are generated. For the end fragments, these extension products incorporate the Primer A sequence. Because Primers A and B are also present in the mixture, extension products are generated for the internal fragments as well.

45. Amplification then proceeds using Primers A and B. All fragments with a Primer A binding site on one end and a Primer B binding site on the other end were exponentially amplified. Any fragments with matching primer binding sites (i.e., two Primer A or two Primer B binding sites on the same fragment) were suppressed through PCR suppression and not exponentially amplified. The PCR suppression and amplification steps are illustrated below.

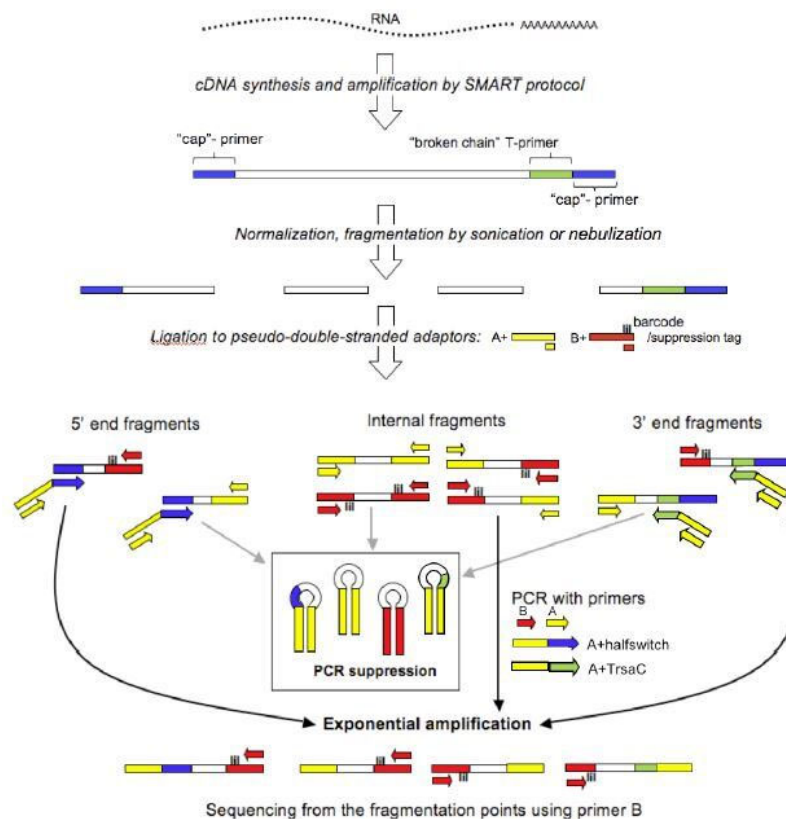


Id., .0003. The top row of fragments reflects the configurations where exponential amplification proceeded. Each fragment only contains one Primer A sequence and one Primer B sequence. The bottom row of fragments contain either two Primer A sequences or two Primer B sequences. These fragments formed hairpins and were not amplified. The box in the top right of the figure shows the configuration of the three types of sequences that were amplified and sequenced. As illustrated in the figure, amplification occurred for all fragments with the proper adaptor arrangement, and PCR suppression occurred with all fragments having two copies of the same adaptor. Because the two types of pseudo-double-stranded adaptors were ligated randomly to all non-capped fragment ends, both end and internal fragments were PCR suppressed.

46. After additional purification steps, we sequenced the fragments using the 454 GS-Flx platform. *Id.*, .0014.

47. As I noted above, we also reported an “improved protocol” that included “minor modifications that we ha[d] recently developed to reduce the number of manipulations required, improve reproducibility, and to further reduce adaptor concatenation.” *Id.* As we noted in Additional File 4, the minor modifications were to the process for “preparing coral larval cDNA.” *Id.*, .0019.

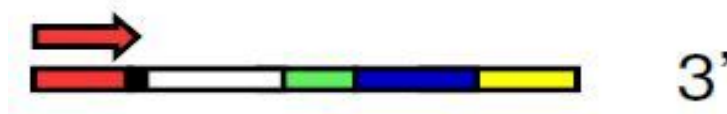
48. The below figure is an accurate representation of this modified method and reflects the changes made to the library preparation method:



49. In the modified method, we introduced a fourth primer, the “A+TrsaC” primer. This primer contains a sequence complementary to the broken T chain rather than the CAP primer. This primer is illustrated below.

A+TRSAC:
 5'-GCCTCCCTCGCGCCATCAG CCGCGCAGGT CGCAGTCGGTACTTTTTCTTTTT
 (A primer sequence) (suppression tag) (sequence of the 3'-portion of the
 "broken chain" cDNA synthesis primer)

Id., .0019. We suggested using this primer because it reduces the length of the subsequent amplicons, which now no longer contain the CAP primer sequence. I have included below an illustration comparing the composition of the amplicon generated from the general method to the amplicon generated from the modified method.



50. As shown by the figure, the CAP primer sequence (which is 23 nucleotides in length, *see* EX1006.0019) is no longer present in the amplicons generated by the modified method. By reducing the read length of the 3' end

fragment further, we could reduce the risk for sequencing errors. We also could conserve space, meaning that more of our sequencing reads were directed to genetic material from the sample and not to adaptors. While that may seem trivial when considering a single fragment, it is not so trivial when sequencing over 600,000 fragments, where this simple fix can reduce the number of nucleotides sequenced by 13.8 million.

V. OUR RESULTS

A. Assembling a Full Larval Transcriptome of *Acropora millepora*

51. Our goal was to demonstrate that it was possible to sequence the entire transcriptome in one sequencing run using our method. From the method, we produced 628,649 raw sequencing reads from a single sequencing run. EX1006.0002. These raw reads correspond to the number of sequencing reads that we received back from the 454 sequencer before we performed any further quality controls.

52. To verify that we were able to sequence the entire transcriptome, we needed to use those reads to assemble the transcriptome. After we trimmed the adaptors from the reads and normalized for size (i.e. size selection), we were able to assemble 44,444 contigs. *Id.*, .0003. A contig is a continuous stretch of overlapping sequencing reads. If we think of a single sequencing read as one piece of a jigsaw puzzle, a contig may be thought of as four or five pieces that fit together.

53. After assembly of the contigs, we were left with 62,657 singletons. *Id.* A singleton is a single sequencing read that cannot be joined to form a contig. While singletons may be unique portions of the transcriptome that do not overlap with other sequencing reads, singletons may also represent sequencing errors, artifacts of cDNA normalization, or contaminants from other sources. Our analysis of the singletons showed that “a substantial fraction” were in fact “artifacts of cDNA synthesis, normalization, or sequencing.” *Id.*, .0010. These singletons would be the equivalent of damaged puzzle pieces that cannot be reliably incorporated into the overall puzzle. Singletons comprised 10% of our sequencing reads. *Id.* While tens of thousands of sequencing reads were unusable, this outcome represented an improvement as compared to other recent 454 transcriptome assemblies where the number of singletons ranged from 13 to 60%. *Id.*

54. We compared the contigs and singletons to known protein sequences. *Id.*, .0005. Because a few thousand singletons returned matches to known proteins, we combined the contig and singleton matches to construct clusters of nucleic acid sequences that allowed us to reconstruct the coral transcriptome. Where assembled sequences matched genes in public databases, we annotated the genes to demonstrate coverage. *Id.*, .0006. From there, we compared the completeness and depth of coverage of our sequencing results to known metabolic pathways, sequences of closely related organisms, and to similar research papers. Through these

comparisons, we confirmed the completeness of our assembled transcriptome and “the potential for our method to improve sequencing depth and efficiency in future transcriptome sequencing efforts.” *Id.*, .0010.

B. Evaluating the 3'-end Bias

55. To test how effective our method was in avoiding a bias towards the 3'-ends of transcripts and in preventing their under-representation due to the “poly-A blinding” problem, we examined how many raw reads contained a single copy of the “broken chain” T sequence. Of the 628,649 raw sequencing reads (EX1006.0002), 98,276 raw reads contained a single copy of the “broken chain” T sequence. That is approximately 15.6% of total raw reads (we report 16% in Meyer). *Id.*, .0009.

56. In isolation, that number alone was not useful to us. We were interested in knowing whether our methods improved on the 454 sequencer and reduced known sequencing errors. To see if our methods succeeded, we compared that number to what we expected might have been the outcome based on a few assumptions.

57. First, we assumed that the average read length of the raw reads (232 nucleotides) was reflective of the population. *See id.*, .0009. As we reported in Meyer, the length of the raw reads ranged from 30 to 474 nucleotides with a standard deviation of 55 nucleotides. *Id.*, .0002.

58. Second, we assumed that the average transcript size was 2,200 nucleotides. *Id.*, .0009. I believe this number was based on the average mRNA

length in mammals, which had been reported to be 2,200 nucleotides. EX2080. Thus, on average we expected to have about 10 fragments (2,200/232) per transcript. Since only one of these fragments would contain a poly-A tail, the fraction of reads with the “broken-T” sequence was expected to be about 10%. The value that we observed, 16%, was a good match to this very approximate “ballpark” estimate: we were happy to find that our method was not off by several fold in terms of over- or under-representation of 3'-end fragments. After all, the goal of the method was to avoid *any* bias in representation of different parts of transcripts. If we wanted to formally test whether 16% actually constitutes enrichment of the 3'-ends, it would have required a much more sophisticated calculation of the expected fraction of 3'-ends, based on the true distribution of coral transcript lengths, which was neither measured in our study nor published elsewhere in the literature, as well as the true distribution of the length of the reads.

C. SNP Validation

59. After sequencing the transcripts and assembling the transcriptome, we also separately evaluated the number of SNPs that were present in the sequencing data. Using a newly developed software program (QualitySNP), we identified around 30,000 potential SNPs. *Id.*, .0009.

60. To confirm the accuracy of the predicted SNPs, we selectively enriched for and sequenced 20 SNPs. *Id.* We used target-specific primer pairs to target and

enrich for each SNP. These primer pairs were reported in Additional File 3 (*see id.*, .0017, which I understand was not included in Exhibit 1006. I also understand that Additional File 3 has now been submitted as Exhibit 2079. I have reviewed that version and can confirm that it is a complete and accurate copy of Additional File 3, which was published contemporaneously with Meyer.

61. After we selectively enriched for the 20 SNPs, we confirmed through Sanger sequencing that 70% of the predicted SNPs were accurate. *Id.*, .0009. These findings demonstrated to us the utility of SNP mining from 454 transcriptome sequences. *Id.*, .0012.

VI. MISUNDERSTANDINGS CONCERNING OUR STUDY

62. I understand that IDT's petition makes representations about our study. Based on my understanding of these representations, I believe that the representations are incorrect for the reasons discussed below.

A. We Did Not Use the Modified Method in Additional File 4

63. I have been informed by counsel for Tecan that there is a dispute concerning which method was used to obtain the data reported in Meyer. We used the method described in Figure 1. In Additional File 4, we provided a "step-by-step protocol for the library preparation method" outlined in the main article. As we noted, the protocol in Additional File 4 "include[d] minor modifications that we ha[d] recently developed to reduce the number of manipulations required, improve

reproducibility, and to further reduce adaptor concatenation.” EX1006.0014. As we also noted in Additional File 4, the minor modifications were to the process for “preparing coral larval cDNA.” *Id.*, .0019.

64. The method illustrated in Additional File 4 was not used in the study to generate the data reported in Meyer. *Id.*, .0002. In fact, we stated in Meyer that the cDNA sample “was prepared from coral larvae as illustrated in Figure 1, and sequenced using the 454 GS-Flx platform.” *Id.* Any claim that the data reported in Meyer was obtained by the modified method illustrated in Additional File 4 is incorrect.

B. Our Methods Did Not Allow for the Selective Enrichment of Specific cDNA Sequences

65. I have been informed by counsel for Tecan that this study has been used in these proceedings to suggest that the primers targeting the CAP primer and broken chain T sequences (as disclosed in Figure 1 and in Additional File 4) result in the selective enrichment of the end fragments. I disagree. Our goal was precisely the opposite: to obtain data that would represent all genes and all parts of all transcripts as evenly as possible, without any preferences or biases.

66. The use of CAP primers and the template-switching (SMART) procedure is the principal innovation of the Clontech SMART cDNA amplification kit (EX1034), which is designed to promote the best possible evenness of representation for all transcript parts in a set of amplified products. A standard (non-

SMART) protocol would produce an over-representation of 3' ends, which the SMART protocol counteracts in two ways. First, it ensures that only the RNA molecules that were reverse transcribed in their entirety are amplified, and it does not amplify strands that are missing the 5' end. *See, e.g.*, EX1034.0004-05. Second, it suppresses shorter, incomplete transcripts through the use of a single CAP primer for cDNA amplification. *See id.* As we stated in Meyer, our protocol took “advantage of the [SMART cDNA synthesis] PCR Suppression effect to preferentially amplify longer molecules and thus enrich for full-length transcripts” and was designed “to minimize distortions of the samples based on previously described principles.” EX1006.0013.

67. We created the broken chain T-primer solely to resolve the “poly-A blinding” problem during 454 sequencing. *Id.*, .0009, .0019. The breaking of the poly-T chain in no way impacted the relative proportion of 3' end fragments that were amplified during library preparation.

68. In the modified method illustrated in Additional File 4, we proposed targeting the broken chain T sequence instead of the CAP primer sequence as a means of reducing the fragment size, which reduced the risk for error and saved sequencing space.

69. Our library preparation scheme (Figure 1) uses CAP primer sequences as anchors to strategically direct the placement of 454 amplification and sequencing

primers (A and B), but it does not enrich for any specific part of a transcript. All fragments with the desired adaptor combination were amplified. We intended for amplification of all fragments because the purpose of our study was to sequence the entire transcriptome as evenly as possible.

70. Our study was not designed to target specific regions of the mRNA transcripts. In order to accurately sequence the entire length of the transcripts, we specifically did not want to enrich certain targets within those transcripts.

71. We chose the SMART cDNA synthesis kit for our coral transcriptome sequencing project because it was designed to isolate and amplify full-length mRNA from a small sample of total RNA, ensuring that the cDNA sample is mostly composed of full-length transcripts and therefore has 5', middle, and 3' end parts of each transcript equally represented. *See* EX1034.0004.

72. In fact, the only discussion in our paper relying on the selective enrichment of target sequences was a separate process not used in Figure 1 or the illustration in Additional File 4. As I mentioned above, after we sequenced the coral transcriptome, we selectively enriched for specific sequences of interest (the 20 SNPs) to validate the accuracy of the sequencing analysis, using PCR with two target-specific primers. *See* EX1006.0009. The primer pairs were reported in Additional File 3. *See* EX2079. We needed to use a different method to target and enrich for these SNPs because the methods used for preparing our coral

transcriptome library were not designed for target enrichment. We also needed to use separate target-specific primer pairs to enrich for specific sequences.

C. Our Data Does Not Show Target Enrichment

73. I have also been informed by counsel for Tecan that the data reported at EX1006.0009 has been interpreted to demonstrate enrichment of the sequencing library (“A single copy of this ‘broken-T’ adaptor was found in 98,276 of the raw reads (16% of the total), slightly more than the expectation (~10%)”). That is not an accurate conclusion based on our work or Meyer.

74. As I explained above, the prediction of the expected fraction of 3' end fragments (10%) is an approximation, and 16% is well within the limits of its uncertainty. This was not a measure of enrichment but a way for confirming that the broken chain T sequence appeared within a reasonable amount of sequencing reads. Nor could it have been a measure of enrichment. To ascertain enrichment, a much more sophisticated calculation of the predicted fraction would be necessary, based on the knowledge of the length distribution of actual coral mRNAs that can only be obtained after whole-genome sequencing. In addition, the method we actually used (as described in Figure 1) did not even use the broken chain T sequence as an anchor to attach the 454 adaptors A and B. *See* EX1006.0002-03. Once again, we designed both methods to amplify all fragment types to ensure that our data captured the entire transcriptome, as described above.

75. The approximate match between the observed and expected fraction of 3' end fragments was meant to demonstrate that our method resolved the 454 sequencer's "poly-A blinding" problem, which would have led to the underrepresentation of 3' ends. We also wanted to ensure that the 3' end was not overly represented (why we used the SMART protocol in the first place, which allowed for us to focus on the homopolymer optical issue instead). The data does not reflect the inadvertent enrichment of the 3' end fragment over other cDNA fragments during amplification: as I explained above, the approximate, back-of-the-envelope nature of our prediction of expected sequences (10%) simply cannot support such an inference. We also never reported in Meyer on the number of 5' end fragments or internal fragments for comparison.

76. As we explained in Meyer, we examined the number of sequence reads with the broken chain T sequence because we were concerned that the 3' end fragments would be underrepresented in the data given the 454 sequencer's struggles with homopolymers. *See* EX1006.0009. The 454 sequencer's homopolymer sequencing issue was known to result in high levels of underrepresentation for affected sequencing reads—sometimes to the point that specific sequencing reads appeared almost non-existent in the data. Given this profound potential impact on the data, we felt that results that were in the ballpark range of what we estimated would reflect success.

77. Any suggestion that the data reflects an enrichment of the 3' end fragments over the other cDNA fragments in our library of fragments that were sequenced misinterprets what we actually reported in Meyer.

VII. CONCLUSION

78. I declare under penalty of perjury that the foregoing is true and correct.

Executed on August 19, 2025, at Monroe, Oregon.

A handwritten signature in cursive script that reads "Eli Meyer".

Eli Meyer, Ph.D.

EXHIBIT A

ELI MEYER

Email: elimeyer@aquabiomics.com | Mobile: +1 (310) 618-4483

Google Scholar: https://scholar.google.com/citations?user=e_pbAkIAAAAJ&hl=en

PROFESSIONAL PROFILE

Accomplished marine biologist, educator, and entrepreneur with 20+ years of experience bridging academic research and real-world applications. Proven excellence in undergraduate and graduate teaching with strong student evaluations and innovative curriculum development. Expert in coral biology, genomics, and environmental physiology with over 40 peer-reviewed publications and extensive grant funding success. Demonstrated ability to translate complex research into practical solutions through entrepreneurial leadership of DNA sequencing business serving aquarium and aquaculture industries.

EDUCATION

Ph.D., Biology | *University of Southern California* | 2006

Marine Environmental Biology | Advisor: Donal T. Manahan

B.S., Marine Science | *Southampton College, Long Island University* | 1998

PROFESSIONAL EXPERIENCE

ENTREPRENEURIAL LEADERSHIP

Founder & CEO | *AquaBiomics LLC* | 2019–present

- Founded first DNA sequencing service for aquarium hobby and aquaculture industry
- Developed innovative microbiome and environmental DNA testing protocols
- Built customer base spanning hobbyists to commercial aquaculture facilities
- Maintained scientific rigor while translating complex genomics to diverse audiences
- Continued research collaborations and publications while leading business operations

ACADEMIC POSITIONS

Assistant Professor | *Integrative Biology, Oregon State University* | 2012–2019

- Taught 5 different courses serving 763 students with consistently above-average evaluations
- Secured \$450,000+ in research funding as PI or Co-PI
- Supervised 3 graduate students, 32 undergraduate researchers, and 18 thesis committees
- Finalist for Outstanding Teaching Award based on student votes (2015)
- Developed innovative curricula including hands-on genomics workshops

Postdoctoral Research Fellow | *University of Texas - Austin* | 2007–2012

- Section of Integrative Biology | Advisors: Thomas E. Juenger & Mikhail V. Matz
- Pioneered genomic approaches for studying coral thermal tolerance and plant stress responses
- Co-developed 2b-RAD genotyping method (published in *Nature Methods*)

Postdoctoral Research Fellow | *University of Southern California* | 2006–2007

- Marine Environmental Biology | Advisor: Donal T. Manahan

TEACHING EXPERIENCE

University Courses

- **Invertebrate Biology (Z 361)** | Oregon State University | 2012–2019
- **Environmental Physiology (Z 423/523)** | Oregon State University | 2014–2019
- **Grant Writing and Ethics (Z 585)** | Oregon State University | 2016
- **Bioinformatics for Biologists (Z 307)** | Oregon State University | 2013

International Training Workshops

- **Summer Genomics Workshops on Catalina** | Catalina Island, CA | 2014–2018
 - Developed and led intensive 9-day hands-on genomics training workshops
 - Trained 70+ participants from 17 countries in wet-lab and computational methods
 - All participants successfully produced and analyzed millions of DNA sequences

- **Advanced Genomics Workshop** | Manila, Philippines | 2014
- **Conserving Coral Reefs Workshop** | Abu Dhabi, UAE | 2013
- **Pan-Pacific Advanced Study Institute** | Dumaguete, Philippines | 2012

Curriculum Development

- Completely redesigned Environmental Physiology course with new content and active learning strategies
- Supervised major revision of Invertebrate Biology lab course with student-centered experiments
- Developed "InvertsWiki" - student-edited resource integrating field work with molecular data
- Created graduate seminar series in bioinformatics and systems biology

RESEARCH PUBLICATIONS

41 peer-reviewed publications | h-index: 30 | i10-index: 42 | 5,744+ citations | multiple papers with 100+ citations

Google Scholar Profile: https://scholar.google.com/citations?user=e_pbAkIAAAAJ&hl=en

Complete Publication List

2022

41. Elder H, Weis VM, Montalvo-Proano J, Mocellin VJL, Baird AH, **Meyer E** and Bay LK (2022) Genetic Variation in Heat Tolerance of the Coral *Platygyra Daedalea* Indicates Potential for Adaptation to Ocean Warming. *Front. Mar. Sci.* 9:925845.

2021

40. Durland, E., De Wit, P., **Meyer, E.**, & Langdon, C. (2021). Larval development in the Pacific oyster and the impacts of ocean acidification: Differential genetic effects in wild and domesticated stocks. *Evolutionary Applications*, 14(9), 2258-2272.
39. Howells, E. J., Abrego, D., Liew, Y. J., Burt, J. A., **Meyer, E.**, & Aranda, M. (2021). Enhancing the heat tolerance of reef-building corals to future warming. *Science Advances*, 7(34).

38. Mostow, R. S., Barreto, F., Biel, R., **Meyer, E.**, and Hacker, S. D. (2021) Discovery of a dune-building hybrid beachgrass (*Ammophila arenaria* × *A. breviligulata*) in the U.S. Pacific Northwest. *Ecosphere* 12(3):e03501.

2020

37. Alama-Bermejo, G., **Meyer, E.**, Atkinson, S. D., Holzer, A. S., Wiśniewska, M. M., Kolísko, M., & Bartholomew, J. L. (2020). Transcriptome-wide comparisons and virulence gene polymorphisms of host-associated genotypes of the cnidarian parasite *Ceratonova shasta* in salmonids. *Genome Biology and Evolution*, 12(8), 1258-1276.

2019

36. Havird, J. C., **Meyer, E.**, Fujita, Y., Vaught, R. C., Henry, R. P., & Santos, S. R. (2019). Disparate responses to salinity across species and organizational levels in anchialine shrimps. *Journal of Experimental Biology*, 222(24).
35. Dziedzic K, Elder H, Tavalire H, **Meyer E** (2019) Heritable variation in bleaching responses and its functional genomic basis in reef-building corals (*Orbicella faveolata*). *Molecular Ecology*, 28(9), 2238-2253.

2018

34. Kirk NL, Howells EJ, Abrego D, Burt JA, **Meyer E** (2018) Genomic and transcriptomic signals of thermal tolerance in heat-tolerant corals (*Platygyra daedalea*) of the Arabian/Persian Gulf. *Molecular Ecology* 27(24):5180-94.

2017

33. Matthews J, Crowder C, Oakley C, Lutz A, Roessner U, **Meyer E**, Grossman A, Weis VW, Davy SK (2017) Optimal nutrient exchange and immune responses operate in partner specificity in the cnidarian-dinoflagellate symbiosis. *Proceedings of the National Academy of Sciences* 114(50) 13194-13199.
32. Crowder C, **Meyer E**, Fan TY, Weis VM (2017) Impacts of temperature and lunar day on gene expression profiles during a monthly reproductive cycle in the brooding coral *Pocillopora damicornis*. *Molecular Ecology* 26(15): 3913–3925.

2016

31. Koenig K, Sun P, **Meyer E**, Gross J (2016). Eye Development and Photoreceptor Differentiation in the Cephalopod *Doryteuthis pealeii*. *Development*.
30. Bhattacharya D, Agrawal S, Aranda M, Baumgarten S, Belcaid M, Drake JL, Erwin D, Foret S, Gates RD, Gruber DF, Kamel B, Lesser MP, Levy O, Liew YJ, MacManes M, Mass T,

Medina M, Mehr S, **Meyer E**, Price DC, Putnam HM, Qiu H, Shinzato C, Shoguchi E, Stokes AJ, Tambutte S, Tchernov D, Voolstra CR, Wagner N, Walker CW, Weber AP, Weis V, Zelzion E, Zoccola D, Falkowski PG (2016). Comparative genomics explains the evolutionary success of reef-forming corals. *eLife* 5(2016): e13288.

29. Howells EJ, Abrego D, **Meyer E**, Kirk NL, Burt JA (2016). Host adaptation and unexpected symbiont partners enable reef-building corals to tolerate extreme temperatures. *Global Change Biology* 22: 2702-2714.

2015

28. Dixon GB, Davies SW, Aglyamova GA, **Meyer E**, Bay LK, Matz MV (2015). Genomic determinants of coral heat tolerance across latitudes. *Science* 348(6242):1460-1462. [400+ citations]
27. Kitchen SA, Crowder CM, Poole AZ, Weis VM, **Meyer E** (2015) De Novo Assembly and Characterization of Four Anthozoan (Phylum Cnidaria) Transcriptomes. *G3: Genes/ Genomes/ Genetics* 5(11):2441-2452.
26. Wright RM, Aglyamova GV, **Meyer E**, Matz MV (2015) Gene expression associated with white syndromes in a reef building coral, *Acropora hyacinthus*. *BMC Genomics* 16(1):371.
25. Lowry DB, Hernandez K, Taylor SH, **Meyer E**, Logan TL, Barry KW, Chapman JA, Rokhsar DS, Schmutz J, Juenger TE (2015) The genetics of divergence and reproductive isolation between ecotypes of *Panicum hallii*. *New Phytologist* 205(1):402-414.

2014

24. Davies SW, **Meyer E**, Guermond SM, Matz MV (2014) A cross-ocean comparison of responses to settlement cues in reef-building corals. *PeerJ* 2:e333.
23. **Meyer E**, Michael AJ, Lowry DB, Palacio-Mejía JD, Logan TL, Fay PA, Juenger TE (2014). Integrating transcriptional, metabolomic, and physiological responses to drought stress and recovery in switchgrass (*Panicum virgatum* L.). *BMC Genomics* 15:527.
22. Willette DA, Allendorf FW, Barber PH, Barshis DJ, Carpenter KE, Crandall ED, Cresko WA, Fernandez-Silva I, Matz MV, **Meyer E**, Santos MD, Seeb LW, Seeb JE (2014) So, you want to use next-generation sequencing in marine systems? Insight from the Pan-Pacific Advanced Studies Institute. *Bulletin of Marine Science* 90(1):79-122.

2013

21. Fletcher RS, Mullen JL, Yoder S, Bauerle WL, Reuning G, Sen S, **Meyer E**, Juenger TE, McKay JK (2013). Development of a next-generation NIL library in *Arabidopsis thaliana* for dissecting complex traits. *BMC Genomics* 14(1):655.
20. Kenkel CD, **Meyer E**, Matz MV (2013). Gene expression under chronic heat stress in populations of the mustard hill coral (*Porites astreoides*) from different thermal environments. *Molecular Ecology*, 22(16), 4322-4334.
19. Davies SW, Rahman M, **Meyer E**, Green EA, Buschiazzi E, Medina M, Matz MV (2013) Novel polymorphic microsatellite markers for population genetics of the endangered Caribbean star coral, *Montastraea faveolata*. *Marine Biodiversity* 43(2): 167-172.

2012

18. **Meyer E**, Weis VM (2012) Study of Cnidarian-algal symbiosis in the "omics" age. *Biological Bulletin* 223:44-65.
17. **Meyer E**, Logan TL, Juenger TE (2012). Transcriptome analysis and gene expression atlas for *Panicum hallii* var. *filipes*, a diploid model for biofuel research. *The Plant Journal* 70:879-90.
16. Wang S, **Meyer E** [equal contributions], McKay JK, Matz MV (2012) 2b-RAD: a simple and flexible method for genome-wide genotyping. *Nature Methods* 9:808-810. [200+ citations]
15. Lowry DB, Purmal CT, **Meyer E**, Juenger TE (2012). Microsatellite markers for the native Texas perennial grass, *Panicum hallii* (Poaceae). *American Journal of Botany* 99:e114:e116.
14. Hunt ME, Modi CK, Aglyamova GV, Ravikant DV, **Meyer E**, Matz MV (2012) Multi-domain GFP-like proteins from two species of marine hydrozoans. *Photochemical & Photobiological Sciences* 11:637-644.

2011

13. **Meyer E**, Aglyamova GV, Matz MV (2011) Profiling gene expression responses of coral larvae (*Acropora millepora*) to elevated temperature and settlement inducers using a novel RNA-Seq procedure. *Molecular Ecology* 20: 3599-3616.
12. Ishak HD, Plowes R, Sen R, Kellner K, **Meyer E**, Estrada DA, Dowd SE, Mueller UG (2011) Bacterial Diversity in *Solenopsis invicta* and *Solenopsis geminata* Ant Colonies Characterized by 16S amplicon 454 Pyrosequencing. *Microbial Ecology* 61: 821-831.

11. Ishak HD, Miller JL, Sen R, Dowd SE, **Meyer E**, Mueller UG (2011) Microbiomes of ant castes implicate new microbial roles in the fungus-growing ant *Trachymyrmex septentrionalis*. *Scientific Reports* 1:204.

2010

10. **Meyer E**, Manahan DT (2010) Gene expression profiling of genetically determined growth variation in bivalve larvae (*Crassostrea gigas*). *Journal of Experimental Biology* 213:749-758.
9. Wang S, Zhang L, **Meyer E**, Bao Z (2010) Genome-wide analysis of transposable elements and tandem repeats in the compact placozoan genome. *Biology Direct* 5:18.
8. Wang S, Zhang L, **Meyer E**, Matz MV (2010) Characterization of a group of MITEs with unusual features from two coral genomes. *PLoS One* 5:e10700.
7. Curole JP, **Meyer E**, Manahan DT, Hedgecock D (2010) Unequal and genotype-dependent expression of mitochondrial genes in larvae of the Pacific oyster *Crassostrea gigas*. *Biological Bulletin* 218:122-131.

2009

6. **Meyer E**, Aglyamova G, Wang S, Buchanan-Carter J, Abrego D, Colbourne J, Willis B, Matz M (2009) Sequencing and de novo analysis of a coral larval transcriptome using 454 GS-Flx. *BMC Genomics* 10:219.
5. **Meyer E**, Davies S, Wang S, Willis BL, Abrego D, Juenger TE, Matz MV (2009) Genetic variation in responses to a settlement cue and elevated temperature in the reef-building coral *Acropora millepora*. *Marine Ecology Progress Series* 392:81-92.
4. Wang S, Zhang L, **Meyer E** and Matz MV (2009) Construction of a high-resolution genetic linkage map and comparative genome analysis for a reef-building coral *Acropora millepora*. *Genome Biology* 10:R126.
3. **Meyer E**, Manahan DT (2009) Nutrient uptake by marine invertebrates: cloning and functional analysis of amino acid transporter genes in developing sea urchins (*Strongylocentrotus purpuratus*). *Biological Bulletin* 217: 6-24.

2007

2. **Meyer E**, Green AJ, Moore M, Manahan DT (2007) Food availability and physiological state of sea urchin larvae (*Strongylocentrotus purpuratus*). *Marine Biology* 152:179-191.

1. Hedgecock D, Lin JZ, DeCola S, Haudenschield CD, **Meyer E**, Manahan DT, Bowen B (2007) Transcriptomic analysis of growth heterosis in larval Pacific oysters (*Crassostrea gigas*). *Proceedings of the National Academy of Sciences* 104:2313-2318.

RESEARCH FUNDING

Funded Grants (Total: \$450,000+)

Coral Adaptation Challenge | Coral Reef Alliance | 2017–2018 | \$18,000 (PI)

Coral adaptation by 2100: A trait-based, evolutionary approach

Ocean Acidification and Hypoxia Effects | Oregon Sea Grant | 2016–2018 | \$229,720 (Co-PI)

Indexing vulnerability and adaptive capacity of marine shellfish

Thermal Acclimation in Corals | OSU CGRB Illumina Sequencing Grant | 2016–2017 | \$6,000 (PI)

Pacific Oyster Climate Resistance | Oregon Sea Grant | 2014–2016 | \$179,998 (Co-PI)

Anemone Systems Biology Model | Oregon Sea Grant Program Development | 2014–2016 | \$9,998 (PI)

Climate Change Research Program | Oregon Sea Grant Program Development | 2014–2016 | \$9,998 (Co-PI)

Genomic Resources Development | OSU General Research Fund | 2014–2015 | \$9,789 (PI)

MENTORING AND ADVISING

Graduate Students

- **Primary Advisor:** 3 PhD students (2013–2019)
- **Thesis Committee Member:** 18 graduate students across multiple departments

Undergraduate Research

- **Volunteer Research Assistants:** 32 students over 7 years
- **Honors College Thesis Supervision:** 3 students
- **Funded Undergraduate Research:** 5 students (URSA-Engage, SURE, STEM Leaders programs)

Postdoctoral Supervision

- **Nathan Kirk** | Postdoctoral Research Fellow | 2013–2014
-

AWARDS AND HONORS

2015 | Finalist, Loyd E. Carter Award for Outstanding and Inspirational Teaching in Science (*student-nominated*)

2006 | Thurlow C. Nelson Award for Best Student Oral Presentation, National Shellfisheries Association

2004–2006 | USC Wrigley Institute of Environmental Studies-Rose Hills Fellowship

2001 | Outstanding Teaching Assistant, Biochemistry, USC

2000 | Outstanding Teaching Assistant, Introduction to Biology - Honors, USC

1999 | Outstanding Teaching Assistant, Introduction to Biology, USC

PROFESSIONAL SERVICE

Editorial and Review Service

- **Peer Review:** 50+ manuscripts for 15+ journals including *Molecular Ecology*, *BMC Genomics*, *PLoS ONE*, *Coral Reefs*, *Biological Bulletin* (2009–present)

Professional Organizations

- **Symposium Organizer:** Physiological Genomics, National Shellfisheries Association, Seattle, WA (2012)

University Service (*Oregon State University, 2012–2019*)

- Chair, Departmental Seminar Committee (2015–2016)
- Graduate Studies Committee (2014–2015, 2016–2017)
- Faculty Search Committees: BPP Ecology & Evolution, IB Marine Evolutionary Systems Biology
- MCB Graduate Admissions Committee (2012–2013, 2014–2015)
- Strategic Planning Committee (2012–2013)

PRESENTATIONS

Invited Seminars

- OSU CGRB Seminar Series (2014)
- Georgia College, Biological and Environmental Sciences (2013)
- Auburn University, Department of Biological Sciences (2013)
- Willamette University, Department of Biology (2013)
- Colorado State University, Bioagricultural Sciences (2011)

Conference Presentations

- International Coral Reef Symposium, Honolulu, HI (2016)
- Society for Integrative and Comparative Biology, Portland, OR (2016)
- Coral Reefs of Arabia, NYU Abu Dhabi Institute, UAE (2015)
- International Coral Reef Symposium, Cairns, Australia (2012)
- Joint Genome Institute User Meeting, Walnut Creek, CA (2010)

PROFESSIONAL DEVELOPMENT

Open Science and Data Sharing

- **Genomic Databases:** Developed and maintained searchable databases for 8+ non-model species
- **GitHub Repository:** Publicly available bioinformatics tools and tutorials
- **Web Analytics:** 46,483+ pageviews from 10,848+ unique visitors in 45+ countries (2012–2019)

Business and Entrepreneurship

- **Technology Transfer:** Successfully commercialized academic research methodologies
- **Science Communication:** Developed expertise in translating complex genomics for diverse audiences

- **Product Development:** Created novel DNA testing protocols for aquarium and aquaculture applications

Last Updated: July 2025

EXHIBIT B

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTEGRATED DNA TECHNOLOGIES, INC.,
Petitioner,

v.

TECAN GENOMICS, INC.,
Patent Owner

Case IPR2025-00015
Case IPR2025-00016
U.S. Patent Nos. 10,036,012 and 10,876,108

DECLARATION OF MIKHAIL V. MATZ, PH.D.

TABLE OF CONTENTS

I.	BACKGROUND AND QUALIFICATIONS	3
II.	THE STUDY IN MEYER FOCUSED ON SEQUENCING THE ENTIRE CORAL TRANSCRIPTOME IN ONE SEQUENCING RUN	6
III.	HOW WE OVERCAME CHALLENGES TO SEQUENCE AN ENTIRE TRANSCRIPTOME	9
A.	Overcoming Bias Towards Highly Abundant Transcripts	9
B.	Overcoming Bias Towards 3'-ends of Transcripts	10
C.	Overcoming Bias Towards Shorter Transcripts	11
D.	Avoiding Non-Productive Sequencing of Artificial Adaptors	11
E.	Avoiding “Blinding” the 454 sequencer with Poly-A Tails	13
IV.	OUR METHOD IN DETAIL	14
V.	OUR RESULTS.....	24
A.	Assembling a Full Larval Transcriptome of <i>Acropora millepora</i>	24
B.	Evaluating the 3'-end Bias.....	26
C.	SNP Validation	27
VI.	MISUNDERSTANDINGS CONCERNING OUR STUDY.....	28
A.	We Did Not Use the Modified Method in Additional File 4.....	28
B.	Our Methods Did Not Allow for the Selective Enrichment of Specific cDNA Sequences	29
C.	Our Data Does Not Show Target Enrichment.....	32
VII.	CONCLUSION	35

I, Mikhail V. Matz, declare as follows:

1. I have been retained by Patent Owner, Tecan Genomics, Inc. (“Tecan”) to provide testimony in this *inter partes* review regarding my work with early NGS techniques.

2. I am the senior author of the research article *Sequencing and de novo analysis of a coral larval transcriptome using 454 GSFlx*, which I understand to be referred to as Meyer, Meyer 2009, or EX1006 in this proceeding. This work was performed in my lab under my direction.

3. Tecan requested that I submit this declaration to aid the Patent Office in its review of Meyer.

4. I understand that there are two *inter partes* review proceedings concerning my work and that IDT relies on my work for its anticipation and obviousness arguments. I have not been asked to provide any opinions as to the ultimate issues of anticipation and obviousness that IDT has raised.

I. BACKGROUND AND QUALIFICATIONS

5. Over the past three decades, I have studied and researched various topics in biochemistry and marine biology, including methods for PCR amplification, PCR suppression, and coral genomics.

6. I obtained my Ph.D. in Biochemistry in 1999 from the Institute of Bioorganic Chemistry in Moscow, Russia. As part of my graduate studies in

Moscow, I researched and published on molecular cloning, cDNA normalization, PCR suppression, and PCR amplification.

7. I conducted my postdoctoral studies in the Whitney Laboratory for Marine Bioscience at the University of Florida, St. Augustine, from October 2000 to May 2001. Afterwards, I became a research assistant professor in the Whitney Lab. I also held a joint appointment as an assistant scientist in the Department of Molecular Genetics and Microbiology at the University of Florida. I held these appointments from May 2001 to August 2006.

8. In August 2006, I joined the University of Texas at Austin as an Assistant Professor in the Integrative Biology section. I have remained at this institution for the past 18 years. I am currently at the rank of tenured full Professor, since August 2019. As part of my responsibilities as an Assistant Professor and now tenured full Professor, I serve as the principal investigator for a genomics research laboratory. As the principal investigator, I oversee the research conducted in the laboratory, including the work described in Meyer. During this time, I have published 95 peer-reviewed papers on coral genomics, transcriptomics, and epigenetics. My research has been referenced in published works of others more than 23,000 times, currently accumulating about 1,500-1,600 new references per year.

9. I understand that one of these publications on sequencing and coral genomics, Meyer, is at issue in these proceedings. We conducted the study described in Meyer in 2008 and submitted it for publication on January 13, 2009. I led the team that developed the methods that were used and oversaw the experiments and analysis that were done. I also helped draft and edit the Meyer manuscript prior to its publication in 2009.

10. Meyer represents a culmination of work between my laboratory, the Center for Genomics and Bioinformatics at Indiana University, and James Cook University in Australia. My laboratory prepared the sequencing library used in Meyer while researchers at James Cook University facilitated sample collection, and researchers at Indiana University sequenced the library with the 454 sequencer. EX1006.0017.

11. I conceived of the study and library preparation methods described in Meyer. *Id.* Postdoctoral researcher Eli Meyer and research assistant Galina Aglyamova helped prepare the cDNA sequencing library used in Meyer. *Id.* Another postdoctoral researcher, Shi Wang, analyzed single nucleotide polymorphisms (“SNPs”) in the sequencing data and validated the results. *Id.* I supervised their work.

12. A copy of my curriculum vitae, attached as **Exhibit A**, contains further details on my education, experience, publications, and the other qualifications allowing me to render an opinion in this matter.

13. I am being compensated my standard rate of \$250 per hour, plus expenses. My compensation is in no way dependent on the content of my testimony or upon the outcome of this proceeding.

14. I have not previously testified as an expert witness.

II. THE STUDY IN MEYER FOCUSED ON SEQUENCING THE ENTIRE CORAL TRANSCRIPTOME IN ONE SEQUENCING RUN

15. In 2008, my lab focused on studying various species of coral and their role in sustaining marine ecosystems. We were interested in understanding the stress tolerance of coral and the interactions between coral and algae—both issues that were poorly understood at the time. This was important to us because it could help us better understand what impact climate change and other environmental stressors would have on marine ecosystems. By 2008, we recognized an urgent need to understand the potential for corals to adapt to climate change. *See* EX1006.0001-02.

16. As we reported in our publication, we felt that new methods were needed for “genomic-scale analysis of emerging model organisms that exemplify important biological questions but lack fully sequenced genomes.” *Id.*, .0001. We believed that NGS could be harnessed to “make possible the detailed studies of gene

expression, genetic connectivity, and stress physiology required for addressing” the questions being investigated by my lab. *Id.*, .0002.

17. While a few studies had already used NGS technology to sequence the transcriptomes for organisms with already completed genomes, we observed a lack of methods for *de novo* assembly and analysis of transcriptomes without a reference genome sequence, which limited the study of emerging model organisms. *Id.* Even more, we noticed that NGS methods had not yet been applied to corals. *Id.* In fact, only a small set of sequencing reads were available for just three coral species. *Id.* Some studies had used Sanger sequencing to identify expressed sequence tags (short sequences that correspond to expressed genes) and partial genome sequences. *Id.* But no coral genome or transcriptome had been completely sequenced and assembled. *See id.*

18. We wanted to facilitate genomics studies in corals and other non-model systems through the use of NGS technologies given their increased throughput, which could expand the amount of known sequencing data. *Id.* NGS was not widespread at the time since it had only been commercially available for a few years. Moreover, in these early days of NGS, researchers had just begun to adapt the technology to their respective disciplines. At the time, the 454 pyrosequencer had been commercially available for about three years, and the Solexa Genome Analyzer

(what would later be acquired by Illumina) had been available for about two years. The Ion Torrent sequencer would not be released for over another year.

19. Not only was NGS relatively new, but researchers were also concerned with the accuracy of the platforms available. While NGS made it possible to sequence considerably larger volumes of genetic material more efficiently, NGS suffered from a number of problems that resulted in lower quality sequencing reads than Sanger sequencing. These concerns were exacerbated when there was no existing reference genome since researchers had no way of comparing to see whether the sequencing reads were inaccurate.

20. Through Meyer, we wanted to demonstrate as a proof of concept that researchers could deep sequence entire transcriptomes of emerging model organisms in a single 454 sequencing run and rely on that sequencing data to *de novo* assemble entire transcriptomes. *See* EX1006.0002. Our improvements to existing methods focused on ways to improve sequencing read output and to assemble catalogs of genes from that output. *Id.* To demonstrate the effectiveness of our improvements, we applied these methods to sequence the larval transcriptome of the coral *Acropora millepora*. *Id.*

21. As we report in Meyer, we succeeded in sequencing the entire transcriptome. *Id.*, .0001. I believe this was one of the earliest instances in which a lab had succeeded in fully sequencing a transcriptome of a non-model organism with

no prior genomic resources, using the 454 sequencing platform. Our study also succeeded in assembling and annotating the transcriptome of the *A. millepora*, which provided critical insight into the genetic makeup of the coral species, furthering other coral research.

III. HOW WE OVERCAME CHALLENGES TO SEQUENCE AN ENTIRE TRANSCRIPTOME

22. The sequencing results reported in Meyer were generated with the 454 GS-Flx sequencing platform. EX1006.0001. Our primary goal in Meyer was to sequence the entire transcriptome. *See id.* This meant that our biggest challenge would be to *avoid the preferential sequencing of certain genes or transcript regions* and to ensure that the whole transcriptome was covered as evenly as possible. This required overcoming biases towards highly abundant transcripts, the 3' ends of transcripts, and shorter transcripts. The second challenge would be to avoid sequencing our own artificial adaptors so that we could maximize the output of actual new coral sequences. The third challenge would be to mitigate 454-specific optical artifacts stemming from the sequencing of the poly-A tails that are present at the 3'-end of every transcript.

A. Overcoming Bias Towards Highly Abundant Transcripts

23. Transcript abundances can vary by several orders of magnitude across genes. If such a sample were to be sequenced directly, we would have enormous sequencing coverage for a small number of genes producing highly abundant

transcripts, while the rest of the transcriptome would get little or no coverage. To solve this problem, we applied the normalization procedure implemented in the Evrogen Trimmer kit. *See* EX1006.0013; EX2081. This procedure equalizes the abundances of transcripts, reducing the difference in their relative representation from several orders of magnitude to just 2-3 fold, reducing the problem dramatically. In Meyer, we applied this normalization procedure after cDNA synthesis and before fragmentation. *Id.*

B. Overcoming Bias Towards 3'-ends of Transcripts

24. In the protocol for cDNA synthesis that we used in Meyer, the cDNA synthesis is initiated using an oligo-dT containing primer, which anneals to the poly-A tail present at the 3'-end of every protein-coding RNA. *Id.* This method of cDNA synthesis was introduced in the 1990s and has an important advantage of selecting against ribosomal RNA, which is of no interest to us but constituted over 90% of the sample.

25. The RNA molecule was then copied by the reverse transcriptase (RT) enzyme into cDNA, going from the 3' to 5' ends of the mRNA. Sometimes, the RT enzyme failed to copy the entire length of the RNA molecule. This was especially more likely to occur the longer the RNA molecule was because the RT enzyme would need to copy more nucleic acids. *See* EX1034.0004. This premature termination of the copying process could lead to over-representation of 3' regions since the copying

process begins at the 3' end. *Id.* In these instances, the 5' end of the RNA molecule would be under-represented in the cDNA copies. *Id.* To avoid the 3' over-representation (and 5' under-representation), we used the SMART cDNA amplification kit (Takara). EX1006.0013. This kit uses a “template-switching” method to amplify RNA molecules that have been copied in their entirety. As such, we were able to ensure that the cDNA copies contained the 5' and 3' ends as well as the nucleic acid sequences in between.

C. Overcoming Bias Towards Shorter Transcripts

26. Polymerase chain reaction (“PCR”) amplification has a well-known tendency to increase the representation of shorter molecules in a mixed sample (such as a transcriptome library), because shorter fragments are amplified more efficiently. *See* EX2081.0009. To combat this tendency during our library preparation procedure, we normalized and amplified the original cDNA library with primers annealing at both ends of each fragment (as per the SMART cDNA amplification protocol). EX1006.0013. We also used a low number of PCR cycles (15) to amplify the normalized library, which reduced the chance for PCR artifacts to accumulate. *Id.*

D. Avoiding Non-Productive Sequencing of Artificial Adaptors

27. If we were to simply take our normalized cDNA sample and use the standard 454 sequencing library preparation kit on it, as much as one-quarter of all

reads would have been unusable, containing mostly or exclusively sequences of adaptors used during the library preparation. To avoid this, we developed the sequencing library preparation scheme that avoids placing the read-initiating primer next to adaptor sequences. This scheme is outlined in Figure 1 below:

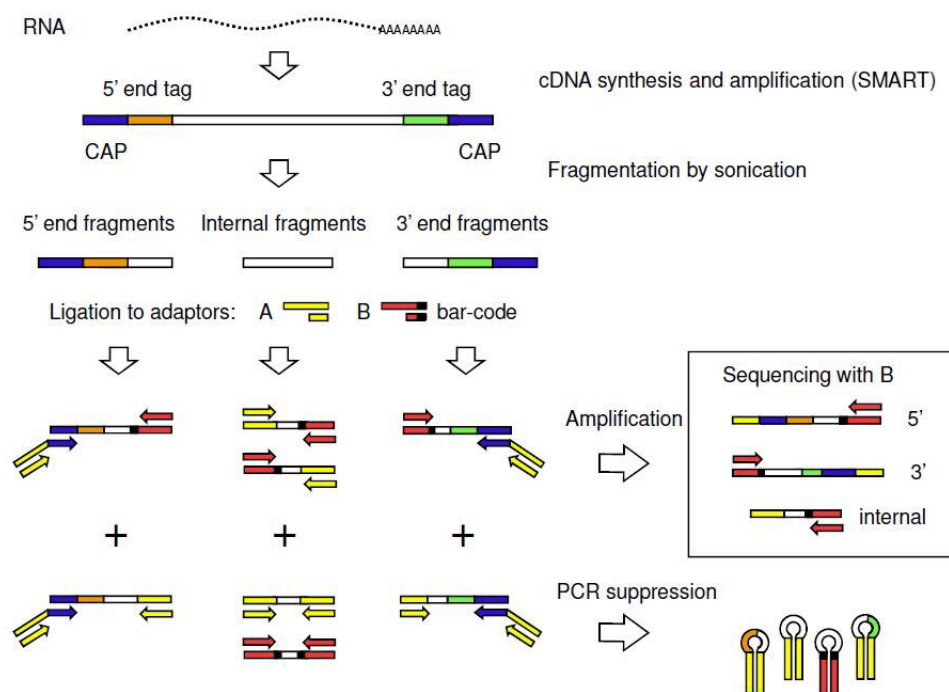


Figure 1
Diagram of cDNA synthesis and 454 library preparation procedures. Three fragment types are produced by sonication: 5', internal, and 3'. Ligation with the partially double-stranded adaptors A and B produces, for each fragment type, certain adaptor configurations that will be amplified (above the '+'), and others that will be suppressed (below the '+') during the subsequent amplification. The procedure preferentially amplifies constructs that are appropriate for 454 sequencing (shown inside box).

EX1006.0003. The read-initiating primer, shown as a red arrow in the figure, always points towards the white part of the DNA, which is the original coral transcript sequence, and is not located next to the adaptors. An additional feature of this scheme is the suppression of amplification for unsequenceable fragments flanked by the same primer on both ends (what we refer to as PCR suppression in Meyer). *Id.*

E. Avoiding “Blinding” the 454 sequencer with Poly-A Tails

28. The 454 sequencer used pyrosequencing by creating DNA complementary to the fragments to be sequenced. This process featured rounds of controlled nucleotide incorporation where the sequencing plate was washed with only one nucleotide species (e.g., A, T, G, C) for any given round. Each incorporation would emit light because of the pyrophosphate released during the reaction. Optical sensors in the 454 sequencer would detect these light emissions for each fragment being sequenced and generate graphs that could be used to identify sequences.

29. In a typical nucleotide sequence where the sequence is varied, a single nucleotide would be added to the complementary sequence, emitting a single signal pulse. However, when several bases of the same kind appear in a row (a homopolymer comprising, for example, sequences CCCC or AAAAAA), the addition of the homopolymer-forming nucleotide in that round results in multiple base incorporations, generating a brighter light signal. The brightness of this signal is used by the 454 instrument to infer how many bases are repeated within the homopolymer sequence.

30. This method can malfunction with the poly-A sequence found at the end of every protein-coding transcript. Assuming a typical library preparation protocol (such as the SMART cDNA amplification kit), the poly-A tail could be 30

bases long. Incorporation of that many nucleotides in the same 454 sequencing round would generate a far stronger burst of light than the 454 platform's sensors were equipped to handle. Such a burst would essentially blind the sensors, throwing off their calibration and leading the instrument to discard the whole read as well as reads in neighboring microwells, which could result in the failure of the whole sequencing run.

31. Even though we ensured that sequencing always starts from the actual coral transcript part (Figure 1), due to the randomness of fragmentation, the coral part can be short enough for the read to run into the adaptor sequence, including the poly-A/T stretch. Even though we used a shorter poly-T-primer than standard (with only 13 “T” bases in a row, *see* EX1006.0013), any sequencing of that region would have led to us having to discard the poly-A/T containing reads and nearby wells. To fix this, we introduced an additional modification: a “broken-T” primer, where we interrupted the T(13) homopolymer with a single “C” base in the middle. *Id.* We did this to avoid the “sensor-blinding” problem with the 454 sequencer.

IV. OUR METHOD IN DETAIL

32. There are two library preparation methods reported in Meyer: the method illustrated in Figure 1 and the method illustrated in Additional File 4. As we reported in the publication, we only used the method reported in Figure 1 to prepare the samples that were sequenced and reported in Meyer. EX1006.0002 (“A cDNA

sample was prepared from coral larvae as illustrated in Figure 1”). Unless otherwise specified, any references I make to the method reported in Meyer refer to the method reported in Figure 1.

33. The method incorporates the solutions outlined above and was used to prepare the mRNA transcripts for sequencing. Figure 1 is an accurate representation of cDNA synthesis and library preparation in the method.

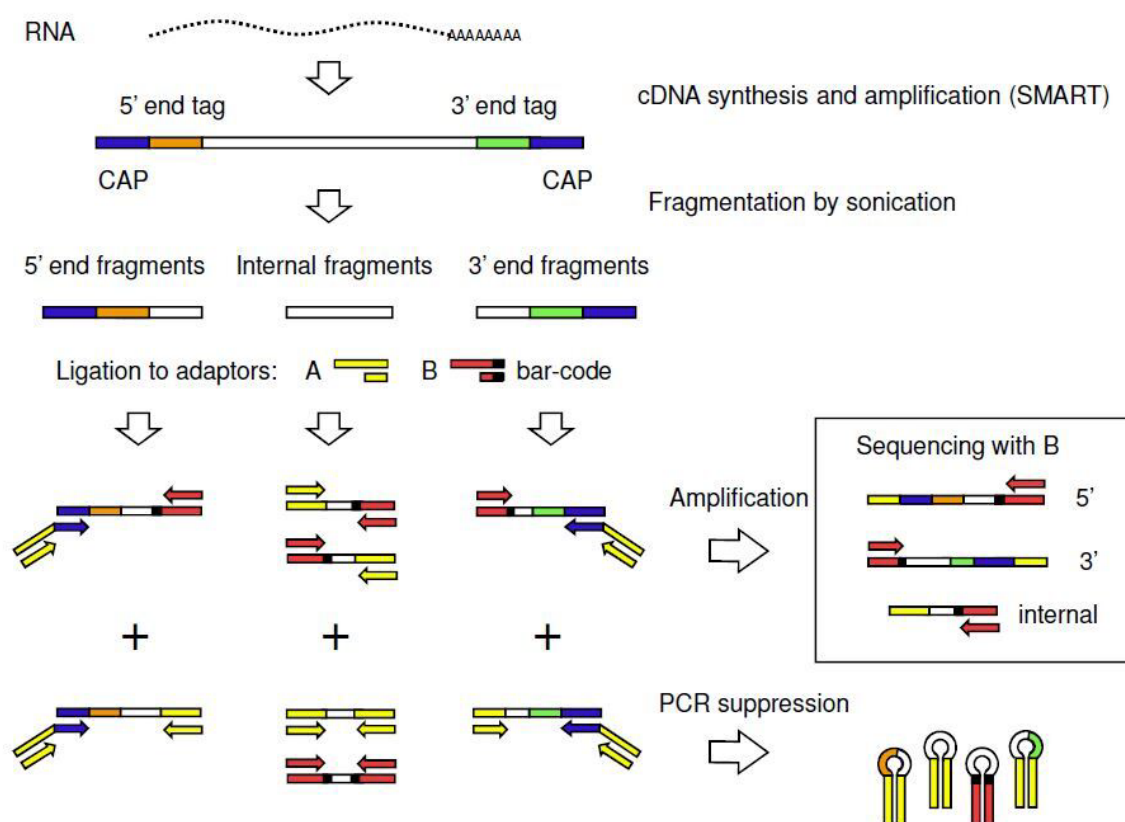


Figure 1
Diagram of cDNA synthesis and 454 library preparation procedures. Three fragment types are produced by sonication: 5', internal, and 3'. Ligation with the partially double-stranded adaptors A and B produces, for each fragment type, certain adaptor configurations that will be amplified (above the '+'), and others that will be suppressed (below the '+') during the subsequent amplification. The procedure preferentially amplifies constructs that are appropriate for 454 sequencing (shown inside box).

34. In our study, we extracted RNA from coral larvae using a standard extraction kit. *Id.*, .0012. We purified the extracted RNA through lithium chloride precipitation, which removes contaminating DNA and proteins. *Id.*, .0012-13. The precipitant was centrifuged and analyzed on a gel to ensure purity. *Id.*, .0021.

35. 454 sequencing required that the RNA be converted to cDNA before the nucleic acids could be sequenced. We used Clontech's SMART cDNA synthesis and amplification kit to reverse transcribe and amplify purified RNA. *Id.*, .0012. This was a standard procedure at the time. We also used this kit because it is designed to only amplify cDNAs that have been reverse-transcribed in their entirety, "preferentially enrich[ing] for full-length cDNAs." EX1034.0004.

36. We followed the manufacturer's instructions for cDNA synthesis, except that the primer used for the first strand of cDNA synthesis was customized to incorporate the broken chain T sequence. We did this "by the inclusion of an internal C to minimize the potential for 454 sequencing problems in [the] homopolymer stretch." EX1006.0013. The modified CAP primer with the broken chain is shown below.

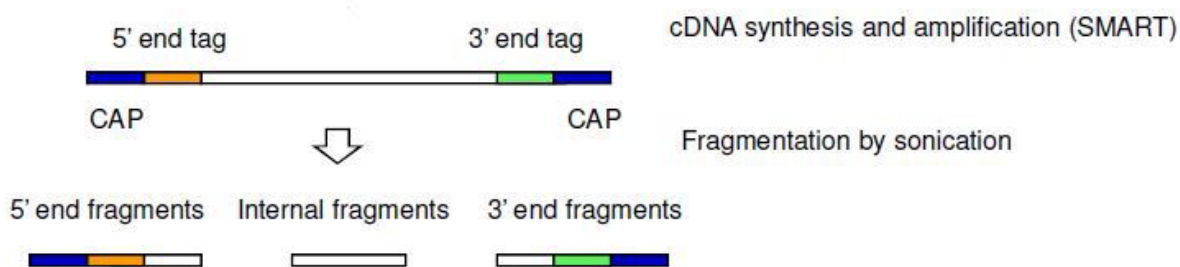
Cap-TRSA-CV (first strand cDNA synthesis primer):
5'- AAGCAGTGGTATCAACGCAGAGT CGCAGTCGGTACTTTTTCTTTTTV – 3'
("cap" primer sequence) ("broken chain" polyT)

Id., .0019.

37. The SMART protocol amplifies the cDNA strands by using the CAP primers. We followed the manufacturer's instructions and used PCR suppression to "preferentially amplify longer molecules and thus enrich for full-length transcripts." *Id.*, .0013. This preferential amplification was important because it counteracts the natural tendency of PCR to amplify shorter molecules over longer ones, which would have created a bias towards shorter transcripts. EX2081.0009. This entire process occurred before fragmentation. *See* EX1006.0013, .0021-23.

38. After we normalized and amplified the full-length cDNA strands, we fragmented them by sonication to produce short, random fragments appropriate for 454 sequencing. *Id.* We optimized this process to produce fragments that were roughly 300-400 nucleotides in length. *Id.*, .0013.

39. As depicted in Figure 1, fragmentation generated three types of fragments: (1) internal fragments that represented most of the regions of the mRNA transcripts; (2) 5' end fragments; and (3) 3' end fragments.



EX1006.0003. The above figure is a simplification of the process and does not reflect the ratio of fragment types. For every pair of end fragments, there were

several internal fragments. Altogether, these fragments represented the entire length of the cDNA strand. The end fragments retained the CAP primers at their termini (shown in blue above). The 5' and 3' end fragments contained slightly different CAP primers with the 3' end fragment CAP primer incorporating the broken chain T sequence (shown in green above).

40. We ligated pseudo-double-stranded adaptors that either contained the Primer A or Primer B sequence to polished cDNA fragments. *Id.*, .0013. These adaptors are illustrated below.

B+ adapter:
Long oligo: 5'-GCCTTGCCAGCCCGCTCAG ACGAGCGGCCA-3'
(B primer sequence) (suppression tag)
Short oligo: 5'-TGGCCGCTCGT-3'

A+ adapter:
Long oligo: 5'-GCCTCCCTCGCGCCATCAG CCGCGCAGGT-3'
(A primer sequence) (suppression tag)
Short oligo: 5'-ACCTGCGCGG-3'

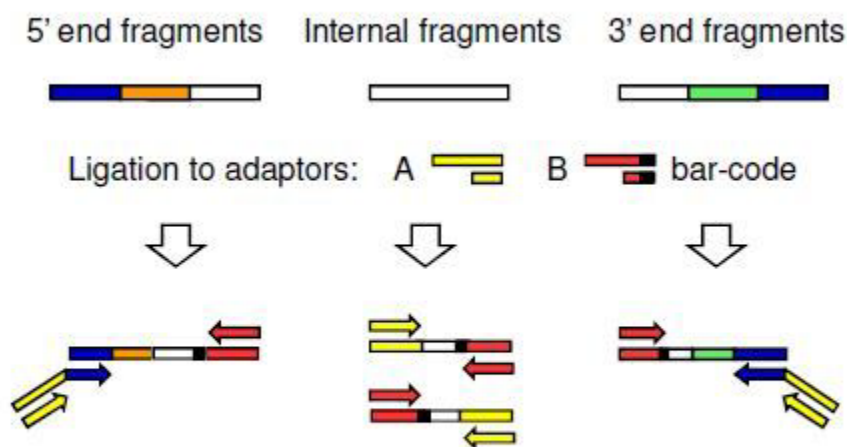
EX1006.0019. As reflected in the illustration, each adaptor contained suppression tags.

41. These adaptors were only ligated to the “new” 5' ends formed as a result of fragmentation/polishing. *Id.* Since the incorporated CAP primer used for cDNA amplification was present on the original ends of the cDNA strands and lacked 5' phosphates, the pseudo-double-stranded adaptors were not able to ligate to them. *Id.* At the initiation of PCR amplification (before the first DNA denaturation step), the

DNA polymerase in the reaction would fill in the primer binding sites on complementary strands.

42. We then annealed the universal primers A and B and a primer known as “A+CAP” to the fragments. *Id.*, .0013. The “A+CAP” primer was complementary to the CAP primer sequences and contained the Primer A sequence at one end of the primer. *Id.* The “A+CAP” primer was used to incorporate the “A+” sequence at each of the original cDNA termini. *Id.*, .0019. This was important because without it, the end fragments could not be attached to the 454 beads for sequencing.

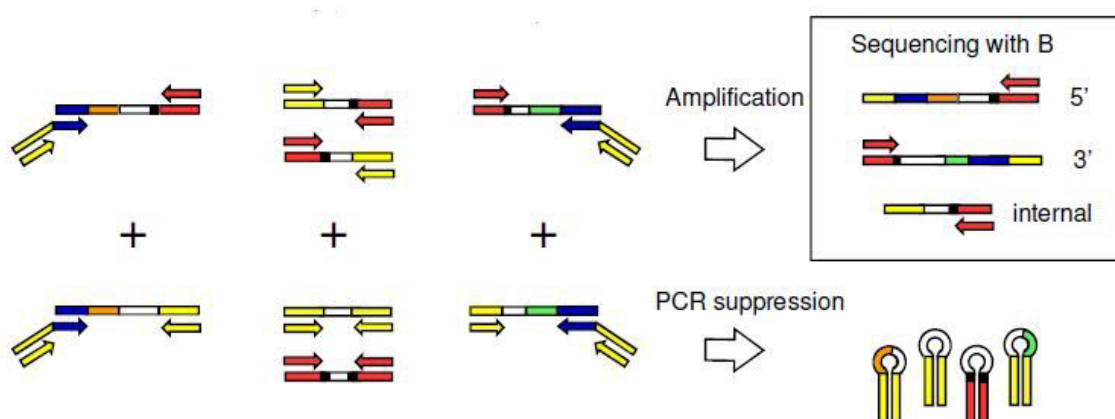
43. The A, B, and “A+CAP” primers were all added to the mixture after adaptor ligation and before annealing. *Id.*, .0013. The directed ligation of the pseudo-double-stranded adaptors and annealing steps are illustrated below.



Id., .0003. The CAP primers (blue) are attached to the two termini of the original cDNA strand. The pseudo-double-stranded adaptors ligate to the uncapped ends of the cDNA fragments (white). The “A+CAP” primers (blue arrows) anneal to the CAP primer sequences. The “A+CAP” primers contain the Primer A sequence (yellow) at their ends.

44. After the primers anneal to their corresponding sequences on the fragments, extension products are generated. For the end fragments, these extension products incorporate the Primer A sequence. Because Primers A and B are also present in the mixture, extension products are generated for the internal fragments as well.

45. Amplification then proceeds using Primers A and B. All fragments with a Primer A binding site on one end and a Primer B binding site on the other end were exponentially amplified. Any fragments with matching primer binding sites (i.e., two Primer A or two Primer B binding sites on the same fragment) were suppressed through PCR suppression and not exponentially amplified. The PCR suppression and amplification steps are illustrated below.

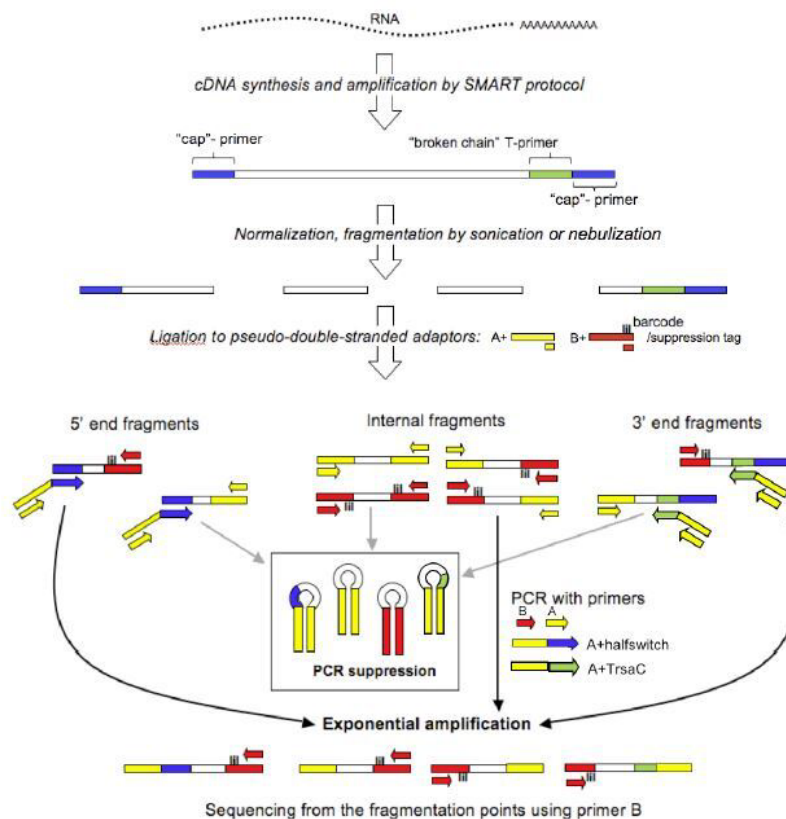


Id., .0003. The top row of fragments reflects the configurations where exponential amplification proceeded. Each fragment only contains one Primer A sequence and one Primer B sequence. The bottom row of fragments contain either two Primer A sequences or two Primer B sequences. These fragments formed hairpins and were not amplified. The box in the top right of the figure shows the configuration of the three types of sequences that were amplified and sequenced. As illustrated in the figure, amplification occurred for all fragments with the proper adaptor arrangement, and PCR suppression occurred with all fragments having two copies of the same adaptor. Because the two types of pseudo-double-stranded adaptors were ligated randomly to all non-capped fragment ends, both end and internal fragments were PCR suppressed.

46. After additional purification steps, we sequenced the fragments using the 454 GS-Flx platform. *Id.*, .0014.

47. As I noted above, we also reported an “improved protocol” that included “minor modifications that we ha[d] recently developed to reduce the number of manipulations required, improve reproducibility, and to further reduce adaptor concatenation.” *Id.* As we noted in Additional File 4, the minor modifications were to the process for “preparing coral larval cDNA.” *Id.*, .0019.

48. The below figure is an accurate representation of this modified method and reflects the changes made to the library preparation method:



49. In the modified method, we introduced a fourth primer, the “A+TrsaC” primer. This primer contains a sequence complementary to the broken T chain rather than the CAP primer. This primer is illustrated below.

A+TRSAC:
 5'-GCCTCCCTCGCGCCATCAG CCGCGCAGGT CGCAGTCGGTACTTTTTCTTTTT
 (A primer sequence) (suppression tag) (sequence of the 3'-portion of the
 “broken chain” cDNA synthesis primer)

Id., .0019. We suggested using this primer because it reduces the length of the subsequent amplicons, which now no longer contain the CAP primer sequence. I have included below an illustration comparing the composition of the amplicon generated from the general method to the amplicon generated from the modified method.



50. As shown by the figure, the CAP primer sequence (which is 23 nucleotides in length, *see* EX1006.0019) is no longer present in the amplicons generated by the modified method. By reducing the read length of the 3' end

fragment further, we could reduce the risk for sequencing errors. We also could conserve space, meaning that more of our sequencing reads were directed to genetic material from the sample and not to adaptors. While that may seem trivial when considering a single fragment, it is not so trivial when sequencing over 600,000 fragments, where this simple fix can reduce the number of nucleotides sequenced by 13.8 million.

V. OUR RESULTS

A. Assembling a Full Larval Transcriptome of *Acropora millepora*

51. Our goal was to demonstrate that it was possible to sequence the entire transcriptome in one sequencing run using our method. From the method, we produced 628,649 raw sequencing reads from a single sequencing run. EX1006.0002. These raw reads correspond to the number of sequencing reads that we received back from the 454 sequencer before we performed any further quality controls.

52. To verify that we were able to sequence the entire transcriptome, we needed to use those reads to assemble the transcriptome. After we trimmed the adaptors from the reads and normalized for size (i.e. size selection), we were able to assemble 44,444 contigs. *Id.*, .0003. A contig is a continuous stretch of overlapping sequencing reads. If we think of a single sequencing read as one piece of a jigsaw puzzle, a contig may be thought of as four or five pieces that fit together.

53. After assembly of the contigs, we were left with 62,657 singletons. *Id.* A singleton is a single sequencing read that cannot be joined to form a contig. While singletons may be unique portions of the transcriptome that do not overlap with other sequencing reads, singletons may also represent sequencing errors, artifacts of cDNA normalization, or contaminants from other sources. Our analysis of the singletons showed that “a substantial fraction” were in fact “artifacts of cDNA synthesis, normalization, or sequencing.” *Id.*, .0010. These singletons would be the equivalent of damaged puzzle pieces that cannot be reliably incorporated into the overall puzzle. Singletons comprised 10% of our sequencing reads. *Id.* While tens of thousands of sequencing reads were unusable, this outcome represented an improvement as compared to other recent 454 transcriptome assemblies where the number of singletons ranged from 13 to 60%. *Id.*

54. We compared the contigs and singletons to known protein sequences. *Id.*, .0005. Because a few thousand singletons returned matches to known proteins, we combined the contig and singleton matches to construct clusters of nucleic acid sequences that allowed us to reconstruct the coral transcriptome. Where assembled sequences matched genes in public databases, we annotated the genes to demonstrate coverage. *Id.*, .0006. From there, we compared the completeness and depth of coverage of our sequencing results to known metabolic pathways, sequences of closely related organisms, and to similar research papers. Through these

comparisons, we confirmed the completeness of our assembled transcriptome and “the potential for our method to improve sequencing depth and efficiency in future transcriptome sequencing efforts.” *Id.*, .0010.

B. Evaluating the 3'-end Bias

55. To test how effective our method was in avoiding a bias towards the 3'-ends of transcripts and in preventing their under-representation due to the “poly-A blinding” problem, we examined how many raw reads contained a single copy of the “broken chain” T sequence. Of the 628,649 raw sequencing reads (EX1006.0002), 98,276 raw reads contained a single copy of the “broken chain” T sequence. That is approximately 15.6% of total raw reads (we report 16% in Meyer). *Id.*, .0009.

56. In isolation, that number alone was not useful to us. We were interested in knowing whether our methods improved on the 454 sequencer and reduced known sequencing errors. To see if our methods succeeded, we compared that number to what we expected might have been the outcome based on a few assumptions.

57. First, we assumed that the average read length of the raw reads (232 nucleotides) was reflective of the population. *See id.*, .0009. As we reported in Meyer, the length of the raw reads ranged from 30 to 474 nucleotides with a standard deviation of 55 nucleotides. *Id.*, .0002.

58. Second, we assumed that the average transcript size was 2,200 nucleotides. *Id.*, .0009. I believe this number was based on the average mRNA

length in mammals, which had been reported to be 2,200 nucleotides. EX2080. Thus, on average we expected to have about 10 fragments (2,200/232) per transcript. Since only one of these fragments would contain a poly-A tail, the fraction of reads with the “broken-T” sequence was expected to be about 10%. The value that we observed, 16%, was a good match to this very approximate “ballpark” estimate: we were happy to find that our method was not off by several fold in terms of over- or under-representation of 3'-end fragments. After all, the goal of the method was to avoid *any* bias in representation of different parts of transcripts. If we wanted to formally test whether 16% actually constitutes enrichment of the 3'-ends, it would have required a much more sophisticated calculation of the expected fraction of 3'-ends, based on the whole distribution of the lengths of actual coral (rather than mammalian) transcripts as well as the distribution of the length of the reads.

C. SNP Validation

59. After sequencing the transcripts and assembling the transcriptome, we also separately evaluated the number of SNPs that were present in the sequencing data. Using a newly developed software program (QualitySNP), we identified around 30,000 potential SNPs. *Id.*, .0009.

60. To confirm the accuracy of the predicted SNPs, we selectively enriched for and sequenced 20 SNPs. *Id.* We used target-specific primer pairs to target and enrich for each SNP. These primer pairs were reported in Additional File 3 (*see*

id., .0017, which I understand was not included in Exhibit 1006. I also understand that Additional File 3 has now been submitted as Exhibit 2079. I have reviewed that version and can confirm that it is a complete and accurate copy of Additional File 3, which was published contemporaneously with Meyer.

61. After we selectively enriched for the 20 SNPs, we confirmed through Sanger sequencing that 70% of the predicted SNPs were accurate. *Id.*, .0009. These findings demonstrated to us the utility of SNP mining from 454 transcriptome sequences. *Id.*, .0012.

VI. MISUNDERSTANDINGS CONCERNING OUR STUDY

62. I understand that IDT's petition makes representations about our study, but several of their positions are incorrect.

A. We Did Not Use the Modified Method in Additional File 4

63. I have been informed by counsel for Tecan that there is a dispute concerning which method was used to obtain the data reported in Meyer. We used the method described in Figure 1. In Additional File 4, we provided a "step-by-step protocol for the library preparation method" outlined in the main article. As we noted, the protocol in Additional File 4 "include[d] minor modifications that we ha[d] recently developed to reduce the number of manipulations required, improve reproducibility, and to further reduce adaptor concatenation." EX1006.0014. As we

also noted in Additional File 4, the minor modifications were to the process for “preparing coral larval cDNA.” *Id.*, .0019.

64. The method illustrated in Additional File 4 was not used in the study to generate the data reported in Meyer. *Id.*, .0002. In fact, we stated in Meyer that the cDNA sample “was prepared from coral larvae as illustrated in Figure 1, and sequenced using the 454 GS-Flx platform.” *Id.* Any claim that the data reported in Meyer was obtained by the modified method illustrated in Additional File 4 is incorrect.

B. Our Methods Did Not Allow for the Selective Enrichment of Specific cDNA Sequences

65. I have been informed by counsel for Tecan that this study has been used in these proceedings to suggest that the primers targeting the CAP primer and broken chain T sequences (as disclosed in Figure 1 and in Additional File 4) result in the selective enrichment of the end fragments. I disagree. Our goal was precisely the opposite: to obtain data that would represent all genes and all parts of all transcripts as evenly as possible, without any preferences or biases.

66. The use of CAP primers and the template-switching (SMART) procedure is the principal innovation of the Clontech SMART cDNA amplification kit (EX1034), which is designed to promote the best possible evenness of representation for all transcript parts in a set of amplified products. A standard (non-SMART) protocol would produce an over-representation of 3' ends, which the

SMART protocol counteracts in two ways. First, it ensures that only the RNA molecules that were reverse transcribed in their entirety are amplified, and it does not amplify strands that are missing the 5' end. *See, e.g.*, EX1034.0004-05. Second, it suppresses shorter, incomplete transcripts through the use of a single CAP primer for cDNA amplification. *See id.* As we stated in Meyer, our protocol took “advantage of the [SMART cDNA synthesis] PCR Suppression effect to preferentially amplify longer molecules and thus enrich for full-length transcripts” and was designed “to minimize distortions of the samples based on previously described principles.” EX1006.0013.

67. We created the broken chain T-primer solely to resolve the “poly-A blinding” problem during 454 sequencing. *Id.*, .0009, .0019. The breaking of the poly-T chain in no way impacted the relative proportion of 3' end fragments that were amplified during library preparation.

68. In the modified method illustrated in Additional File 4, we proposed targeting the broken chain T sequence instead of the CAP primer sequence as a means of reducing the fragment size, which reduced the risk for error and saved sequencing space.

69. Our library preparation scheme (Figure 1) uses CAP primer sequences as anchors to strategically direct the placement of 454 amplification and sequencing primers (A and B), but it does not enrich for any specific part of a transcript. All

fragments with the desired adaptor combination were amplified. We intended for amplification of all fragments because the purpose of our study was to sequence the entire transcriptome as evenly as possible.

70. Our study was not designed to target specific regions of the mRNA transcripts. In order to accurately sequence the entire length of the transcripts, we specifically did not want to enrich certain targets within those transcripts.

71. We chose the SMART cDNA synthesis kit for our coral transcriptome sequencing project because it was designed to isolate and amplify full-length mRNA from a small sample of total RNA, ensuring that the cDNA sample is mostly composed of full-length transcripts and therefore has 5', middle, and 3' end parts of each transcript equally represented. *See* EX1034.0004.

72. In fact, the only discussion in our paper relying on the selective enrichment of target sequences was a separate process not used in Figure 1 or the illustration in Additional File 4. As I mentioned above, after we sequenced the coral transcriptome, we selectively enriched for specific sequences of interest (the 20 SNPs) to validate the accuracy of the sequencing analysis, using PCR with two target-specific primers. *See* EX1006.0009. The primer pairs were reported in Additional File 3. *See* EX2079. We needed to use a different method to target and enrich for these SNPs because the methods used for preparing our coral

transcriptome library were not designed for target enrichment. We also needed to use separate target-specific primer pairs to enrich for specific sequences.

C. Our Data Does Not Show Target Enrichment

73. I have also been informed by counsel for Tecan that the data reported at EX1006.0009 has been interpreted to demonstrate enrichment of the sequencing library (“A single copy of this ‘broken-T’ adaptor was found in 98,276 of the raw reads (16% of the total), slightly more than the expectation (~10%)”). That is not an accurate conclusion based on our work or Meyer.

74. As I explained above, the prediction of the expected fraction of 3' end fragments (10%) is an approximation, and 16% is well within the limits of its uncertainty. This was not a measure of enrichment but a way for confirming that the broken chain T sequence appeared within a reasonable amount of sequencing reads. Nor could it have been a measure of enrichment. To ascertain enrichment, a much more sophisticated calculation of the predicted fraction would be necessary, based on the knowledge of the length distribution of actual coral mRNAs that can only be obtained after whole-genome sequencing. In addition, the method we actually used (as described in Figure 1) did not even use the broken chain T sequence as an anchor to attach the 454 adaptors A and B. *See* EX1006.0002-03. Once again, we designed both methods to amplify all fragment types to ensure that our data captured the entire transcriptome, as described above.

75. The approximate match between the observed and expected fraction of 3' end fragments was meant to demonstrate that our method resolved the 454 sequencer's "poly-A blinding" problem, which would have led to the underrepresentation of 3' ends. We also wanted to ensure that the 3' end was not overly represented (why we used the SMART protocol in the first place, which allowed for us to focus on the homopolymer optical issue instead). The data does not reflect the inadvertent enrichment of the 3' end fragment over other cDNA fragments during amplification: as I explained above, the approximate, back-of-the-envelope nature of our prediction of expected sequences (10%) simply cannot support such an inference. We also never reported in Meyer on the number of 5' end fragments or internal fragments for comparison.

76. As we explained in Meyer, we examined the number of sequence reads with the broken chain T sequence because we were concerned that the 3' end fragments would be underrepresented in the data given the 454 sequencer's struggles with homopolymers. *See* EX1006.0009. The 454 sequencer's homopolymer sequencing issue was known to result in high levels of underrepresentation for affected sequencing reads—sometimes to the point that specific sequencing reads appeared almost non-existent in the data. Given this profound potential impact on the data, we felt that results that were in the ballpark range of what we estimated would reflect success.

77. Any suggestion that the data reflects an enrichment of the 3' end fragments over the other cDNA fragments in our library of fragments that were sequenced misinterprets what we actually reported in Meyer.

VII. CONCLUSION

78. I declare under penalty of perjury that the foregoing is true and correct.

Executed on July 17, 2025, at Austin, Texas.

A handwritten signature in black ink, appearing to read 'Mikhail V. Matz', written above a horizontal line.

Mikhail V. Matz, Ph.D.