2013-12-01

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Nuttall, Brittany Marie, "The Effects of Isolation on Endemic Cozumel Island Rodents: A Test of the Island Rule" (2013). *All Theses and Dissertations*. 4263.
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The Effects of Isolation on Endemic Cozumel Island Rodents:

A Test of the Island Rule

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A thesis submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of

Master of Science

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December 2013

ABSTRACT

The Effects of Isolation on Endemic Cozumel Island Rodents: A Test of the Island Rule

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Island isolation can cause changes in body size, cranial characteristics, and genetic variation in mammals. We use geometric morphometrics to test skull and mandible shape and size change across three species of endemic Cozumel Island rodents in order to test the "island rule" of larger size in isolated rodents. We also sequenced the D-Loop and cytochrome b region of the mitochondrial genome and tested for differences in genetic variation between island and mainland groups, as well as population structure and gene flow in order to assess the effect of island isolation on these three rodents. We found that the three species of rodents showed varying degrees of size and shape differences from island to mainland with some species varying considerably and others not at all. The genetic results were similar with some species exhibiting potential founder effects, while others showed little differentiation between the island and mainland. We conclude that evolution on islands is highly conditional on the history, community composition, and biology of the colonizing species.

Keywords: island rule, geometric morphometrics, Cozumel, *Reithrodontomys spectabilis*, *Reithrodontomys gracilis*, *Oryzomys couesi*, *Peromyscus leucopus*

ACKNOWLEDGMENTS

I thank Brigham Young University and the Department of Biology for providing funding for this research. I also thank my committee chair Duke S. Rogers for being my advisor and guide throughout my research. Many thanks to Mark C. Belk and Jerry B. Johnson for their work as my committee members. In particular I acknowledge Mark C. Belk in his work on the statistical analysis of this publication. Thank you to the following institutions and individuals for providing tissue and skull loans: Robert Dowler of Angelo State Natural History Museum, Robert Timm of the University of Kansas Natural History Museum, and Mark D. Engstrom of the Royal Ontario Museum. I express gratitude for my family and friends for their support. Most importantly, I thank my husband John Nuttall for his support and encouragement to reach for my dreams.

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INTRODUCTION

Island mammals typically exhibit shifts in body size as well as differences in cranial, skeletal and dental characteristics compared to their mainland counterparts. These morphological changes are variously referred to as the “island rule”, “island effect” or “island syndrome” which is manifested by evolution of larger size in smaller mammals and shifts to dwarfism in larger mammals (Gompper, Petrites & Lyman, 2006; Van Valen, 1973).

Lomolino (2005) assessed the generality of the island rule by comparing means of species body size of selected insular mammals to their nearest mainland counterpart. He found that the majority of changes were consistent with the island rule, in which there was a graded trend toward gigantism in smaller species and dwarfism in larger species. Lomolino (2005) hypothesized that this trend is a result of selection to converge on an optimal body size for a given species for a certain ecological strategy. He further suggested that mainland populations do not reach this optimum due to interspecific challenges and temporal and spatial variation in environmental characteristics (Case, 1978; Grant, 1965; Lomolino, 1985). Other possibilities for body size shifts on islands include ecological release, resource limitation, and immigrant selection.

Studies showing the generality of the island rule (Bromham & Cardillo, 2007; Gompper et al., 2006; Krystufek, Tvrtkovic, Paunovic & Ozkan, 2009; White & Searle, 2007) have been criticized on the basis of inadequate size indices (Meiri, Dayan & Simberloff, 2006), distantly related island mainland pairs, exceedingly large islands, and phylogenetically non-independent data (Meiri, Cooper & Purvis, 2008). In response to these criticisms, Meiri et al. (2008) conducted a study comparing island and mainland conspecifics, using islands less than 50,000 km^2. Their analyses also favored indices based on body mass rather than other measurements, and used only adult specimens of known sex. Meiri et al. (2008) found that evolution on islands is highly conditional on history, community composition, and biology of the colonizing species. Certain clades favor insular dwarfism (artiodactyls, heteromyids, and some carnivores) or insular gigantism (murid rodents) while others (e.g. shrews, squirrels and bats) exhibited no such tendencies. Hence, it is unclear if the island rule applies broadly across all taxonomic groups.

In addition to body size, other factors, such as body shape and genetic variation, are likely to be influenced by island isolation. Island populations have been shown to have lower levels of genetic diversity than their mainland counterparts (Frankham, 1997). According to Kilpatrick (1981) a major cause of this loss of diversity in rodents is the result of a founder event. Island evolution is likely to be more complicated than just a change in body size. To determine the effect of island isolation on not only body size, but also body shape and genetic variation, an island/mainland system of several replicated rodent species would be preferable in order to compare changes across different groups in the same system.

Cozumel Island is located approximately 18 km off the Caribbean coast of the Mexican state of Quintana Roo and is separated from the mainland by a 914 m deep channel. The island is about 36 km long and 15 km wide with an area of approximately 540 km^2. It has a subtropical climate with seasonal rainfall, high humidity, and nearly constant warm temperatures. The island is often impacted by hurricanes and tropical storms. The formation of Cozumel Island apparently occurred when high blocks on the Yucatán Peninsula became isolated carbonate banks at least during the late Quaternary (0.5-1 million years). Analysis of the exposed limestone on the island suggests that there have been two periods of submergence and two periods of exposure during the late Pleistocene, with the last submergence occurring about 125,000 B.*P.* (Spaw, 1978).

Currently, Cozumel Island has 31 endemic animal taxa including three rodents: *Reithrodontomys spectabilis* (Cozumel Harvest Mouse), *Oryzomys couesi cozumelae* (Cozumel Coues' Rice Rat), and *Peromyscus leucopus cozumelae* (Cozumel White-footed Mouse) (Fuentes-Montemayor, Cuaron, Vazquez-Dominguez, Benitez-Malvido, Valenzuela-Galvan & Andresen, 2009).

Reithrodontomys spectabilis is one of the largest species in the genus, and was allied with *R. mexicanus* and *R. gracilis* of the *R. mexicanus* species group when it was first described by Jones and Lawlor (1965). Due to the great morphological differences in size between *R. gracilis* and *R. spectabilis*, Jones and Lawlor (1965) hypothesized that the two have been separated for a relatively long time, perhaps since the late Pleistocene. More recently, *R. spectabilis* and *R. gracilis* were found to be sister taxa and not closely related to *R. mexicanus* based on allozyme and mitochondrial cytochrome *b* (*Cytb*) sequence data (Arellano, Gonzalez-Cozatl & Rogers, 2005; Arellano, Rogers & Cervantes, 2003). Interestingly, *R. gracilis* was rendered paraphyletic or formed an unresolved node with *R. spectabilis* samples based on *Cytb* sequence data.

Oryzomys couesi cozumelae (Merriam, 1901) was originally regarded as a species-level taxon, but later was relegated to subspecific rank as *O. couesi cozumelae* (Jones & Lawlor, 1965). It differs from mainland populations currently regarded as *O. c. couesi* by overall larger external size. The cranial differences between these two forms are considered minor (Engstrom, Schmidt, Morales & Dowler, 1989). It was also demonstrated that *O. c. cozumelae* exhibits high genetic and allelic diversity which is in contrast with what is expected from island animal populations (Vega, Vazquez-Dominguez, Mejia-Puente & Cuaron, 2007).

Peromyscus leucopus cozumelae (Merriam, 1901) was originally described as a species but later was regarded as a subspecies of *P. leucopus* by Osgood (1909). In 1984 it was the most common small mammal found on the island (Engstrom et al., 1989). However it has not been captured since 2001 (Fuentes-Montemayor et al., 2009). It differs from its mainland counterpart (*P. l. casteneus*) by overall larger external and cranial size, as well as heavier teeth (Jones & Lawlor, 1965).

These three endemic Cozumel Island rodents each exhibit a general size increase when compared to their mainland counterparts and generally adhere to the island rule; however, only *Reithrodontomys spectabilis* is regarded as specifically distinct. This likely is due to the greater morphological differences between *R. spectabilis* and *R. gracilis* compared to observed morphological differences in *Oryzomys couesi* and *Peromyscus leucopus* island/mainland populations.

Recently, researchers have used geometric morphometrics to detect and quantify differences in size and shape (Barciova & Macholan, 2006; Nagorsen & Cardini, 2009; Nunes, Piorski & De Araoujo, 2008; Rohlf & Marcus, 1993). This tool allows researchers to detect morphological differences that previously were difficult to measure and compare. Morphometrics itself is the study of shape variation and its covariation with other variables (Adams, Rohlf & Slice, 2004; Bookstein, 1991; Dryden & Mardia, 1998). Investigators have used this technique to compare interspecific changes in skulls (Cardini, 2003; Corti, Aguilera & Capanna, 2001; McNulty, 2004). In addition, researchers have used geometric morphometrics to compare and contrast island populations from mainland populations (Nagorsen & Cardini, 2009; White & Searle, 2008).

Here, we use geometric morphometrics to compare skull and mandible shape and size of the three island rodents to their mainland counterparts in order to explore the “influence” of island isolations on these three rodent pairs. Should the island rule apply broadly, one could predict that all three rodents would change in skull size. Therefore, we predict that all three rodent species will have larger skulls compared to those on the mainland. However, it is unknown whether we should expect identical shape changes across all three pairs of taxa. In addition, because populations of endemic rodents are isolated on Cozumel Island we predict that these populations will have experienced a loss of genetic diversity, genetic bottlenecks, and higher inbreeding, or a combination of all these when compared to their mainland counterparts. To test this prediction, we sequenced two parts of the mitochondrial genome (cytochrome b and the D-loop or control region), and compared diversity measurements. We are also interested in determining how population genetic structuring differs between island and mainland rodents and we predict island populations should also have a more structured population and reduced or no gene flow with adjacent populations on the Yucatan Peninsula. Unlike other island studies, this study will be able to quantify the "island effect" in skull/mandible shape, size, and genetic variation across three pairs of differing species isolated on the same island, which will help identify any common differences that may come from the island.

MATERIALS AND METHODS

Geometric Morphometrics

Skulls and mandibles of *R. gracilis*, *R. spectabilis*, *O. couesi*, and *P. leucopus* from the Yucatan Peninsula and Cozumel Island were obtained through Angelo State University and the University of Kansas (Appendix 1). A total of 322 specimens were analyzed. This included 106 *O. couesi* (46 island samples, 60 mainland samples), 120 *P. leucopus* (96 island samples, and 24 mainland samples), and 96 *Reithrodontomys* (31 island samples, 61 mainland samples (Figure 1, Figure 2, Figure 3). Individuals included in all analyses were adults, evidenced by completely fused skulls and fully erupted teeth.

We captured images of the mandible and dorsal and ventral views of the skull using a Nikon D50 Digital SLR camera with a 60 mm f/ 2.8D AS Micro-Nikkor lens at a resolution of 3008 x 2000 pixels. Landmarks were collected using the TPSdig software (Rohlf, 2008) and were determined to be homologous across the three genera of rodents examined. Thirteen landmarks were chosen for the dorsal view of the skull (Table 1 and Figure 4a). Landmarks 11 and 9 were designated semilandmarks because we were only interested in the variability in the breadth of these landmarks. For the ventral view of the skull, 19 landmarks were chosen with points 13 and 14 designated as semilandmarks (Table 2 and Figure 4b). Due to the bilateral symmetry of skulls, only half of the skull was landmarked. This limited any redundant information. Twelve landmarks were chosen for the mandible (Table 3 and Figure 4c). Landmarks were chosen to highlight potential functional areas of the skull/mandible that could be most easily influenced by environmental factors (i.e. toothrow) (Cardini, 2003; Klingenberg, Leamy & Cheverud, 2004).

The shape of an object is the variation that remains after the object has been moved, rotated, enlarged, or reduced (Bookstein, 1998). TPSrelw (Rohlf, 2008) was used to dismiss any non-shape variation by using Generalized Procrustes Analysis (GPA) for superimposition. The slide method was set to chord min- d^2 and a consensus view was obtained.

Relative warps were then calculated from a principal components analysis to allow multi-dimensional information to be more easily viewed. For the dorsal view, 22 relative warps were retrieved and the first 15 were used in the analysis. Of these, the first two warps contained 66.56% of the informative shape change. For the ventral view, 34 relative warps were retrieved and the first 15 were used in the analysis, with the first two describing 56.14% of the shape change. For the mandible, 20 relative warps were obtained and the first 12 were used in the analysis with the first two describing 61.97% of the shape change.

Shape variation was analyzed with a multivariate mixed model using proc MIXED in SAS (2008). Because relative warps are orthogonal and ordered, they can be treated as repeated measures with the use of an index variable. The identifying order number of the relative warps was treated as an index variable and included in the mixed model analysis. This was done according following Hassell, et al. (2012), and Wesner, et al. (2011). Main effects included island/mainland, male/female, and species. All interactions among main effects were included in the analysis. The interaction between main effects and the index variable provides the most direct test of our hypothesis because the index variable tests for differences in shape on each of the relative warps independently (Wesner et al., 2011). In addition to the statistical assay on shape change, and in order to view size only variation, a paired t test was performed on the centroid sizes from each species pair in order to assess any size difference between island/mainland pairs.

Molecular Analyses

DNA sequences of the mitochondrial cytochrome *b* (cyt-*b*) and the D-loop were used to assess the amount of genetic variation present both between and among island/mainland counterparts. Mitochondrial DNA (mtDNA) has been the genetic marker most often used in comparing within and among population variation in mammals (Searle, Jamieson, Gunduz, Stevens, Jones, Gemmill & King, 2009). When compared to nuclear genes, there is evidence that mtDNA acts as a good marker for a first colonization event (Searle et al., 2009). Moreover due to its maternal inheritance, high mutation, rate, single-copy orthologous genes, and lack of recombination this gene is appropriate for evolutionary studies focusing within or among correlated species (Larizza, Pesole, Reyes, Sbisa & Saccone, 2002) such that it has become the marker of choice for many systematists (Bradley & Baker, 2001). The D-Loop region, located between the genes $tRNA^{Phe}$ and $tRNA^{Pro}$, is the main non-coding region in mtDNA (Fernandez-Silva, Enriquez & Montoya, 2003), and exhibits high with-in species variability (Forster, Gunduz, Nunes, Gabriel, Ramalhinho, Mathias, Britton-Davidian & Searle, 2009). The D-loop region is especially well suited for this study due to its high variability even among members of the same species and subspecies (Larizza et al., 2002; Searle et al., 2009). As a result, species-specific evolution is evident in this region (Pesole, Gissi, De Chirico & Saccone, 1999).

Tissues were obtained by loan from Angelo State University and the Royal Ontario Museum (Appendix 1). Sequence data were obtained from 290 individuals, including 38 samples of *Reithrodontomys spectabilis*, 48 samples of *Reithrodontomys gracilis*, 126 samples of *Oryzomys couesi* (25 from the island, 101 from the mainland), and 72 samples of *Peromyscus leucopus* (68 from the island, 4 from the mainland). All mainland samples of *R. gracilis* and *O. couesi* were restricted to the greater Yucatan Peninsula. Because of the lack of Yucatan Peninsular samples for *Peromyscus leucopus* we included six more samples from outlying regions in Mexico (see Figure 1, Figure 2, Figure 3).

Whole genomic DNA from each individual was extracted from tissue either frozen or preserved in 95% ethanol using the Qiagen DNeasy™ Tissue Kit (Cat. No. 69504), and the Qiagen QIAamp™ DNA Micro Kit (Cat. No. 56304). PCR was used to amplify the entire cyt b gene (1143 bp) using primers MVZ-05-M (5’ - CTT GAT ATG AAA AAC CAT CGT TG – 3’) with MVZ-14-M (5’ - CTT GAT ATG AAA AAC CAT CGT TG – 3’) (Smith & Patton, 1993). Internal primers included MVZ 16 (5’-TAG GAA RTA TCA YTC TGG TTT RAT – 3’), MVZ

45 (5’-GTH ATA GCH ACA GCA TTY ATA GG-3’) (Smith & Patton, 1993), CB40 (5’ - GCT TTG GGT GCT GGT GGT GG – 3’) (Hanson & Bradley, 2008), and F1 (5’ - TGA GGA CAR ATA TCH TTY TGR GG – 3’) (Whiting, Bauer & Sites, 2003). The mtDNA control region for *Reithrodontomys* (873 bp) and *Peromyscus* (933 bp) was amplified using the primers LGL283mod (5’ – TAC NCT GGT CTT GTA AAC C – 3’) (modified from (Bickham, Patton & Loughlin, 1996), and H21 (5’ – GCA TTT TCA GTG CTT TGC TT – 3’) (Yasuda, Vogel, Tsuchiya, Han, Lin & Suzuki, 2005). When the primers above were used for the samples of *Oryzomys couesi*, the PCR product yielded bright bands, but the sequences returned were double peaked, possibly due to the presence of a pseudogene. Therefore primers designed specifically for this study were used to amplify the control region of *Oryzomys couesi* (652 bp): OCF (5’ – GCT TTG GGT GCT GGT GGT GG – 3’) and OCR (5’ – GCC TTG ACG GCT ATG GTG AG – 3’) and produced single peaks when sequenced. The PCR protocol for the control region primers LGL283mod and H21 included an initial denaturation at 94°C (5 min), 35 cycles with denaturation at 93°C (30 sec), annealing 51°C (1 min), extension at 72°C (1 min 30 sec), and a final extension cycle of 72°C (7 min). The PCR protocol for primers OCF and OCR included an initial denaturation at 93.5°C (1 min), 35 cycles with denaturation at 93.5°C (40 sec), annealing 58°C (40 sec), extension at 72°C (2 min 40 sec), and a final extension cycle of 72°C (2 min).

The resulting polymerase chain reaction products were purified using a Millipore Multiscreen^{TM} 96-Well Filtration System (Cat. N*O.* MANU03050). Sequencing was performed using the Applied Biosystems Big Dye v.3.1 Dye Terminator Cycle Sequencing Ready Reaction Kit (PE Applied Biosystems, Foster City, CA). Excess dye terminator was removed using Millipore Multiscreen^{TM} Filter Plates for High Throughput Separations (Cat. N*O.* MAHVN4510). Sequences were determined using the Perkin-Elmer ABI Prism 377 housed at

Brigham Young University. Sequences were then edited manually using the original chromatograph data in the program Geneious (http://www.geneious.com/; Bradley, Edwards, Carroll & Kilpatrick, 2004) version 5.6.5. The resulting sequences were aligned with the MAFFT v. 1.3 software (Katoh, Misawa, KUma & Miyata, 2002). The aligned sequences were further examined using Mesquite v. 2.73 (Maddison & Maddison, 2010).

Population Genetic Analyses

We predicted island populations would possess lower levels of population diversity than mainland populations. To test this prediction we calculated nucleotide diversity π (Tajima, 1993), θ (π) (Tajima, 1983), and θ (S) (Watterson, 1975) using Arlequin v. 3.5.1.2 (Excoffier et al., 2005). Input files for Arlequin were created using Dnasp v. 5 (Librado & Rozas, 2009). Due to the likelihood of sampling error, standard deviations for all diversity measurements were calculated in Arlequin (Excoffier et al., 2005). The standard deviation of nucleotide diversity π was calculated according to Tajima (1993), Wattterson's estimate (θ (S)) as per Tajima (1989) and θ (π) by Nei (1987).

To assess the degree of genetic variation among mainland and island populations, F statistics were calculated using a hierarchical analysis of molecular variance (AMOVA) as implemented in Arlequin (Excoffier et al., 2005). Corresponding probabilities were inferred with 10 000 permutations. We also calculated the genealogical sorting index (gsi) of Cummings et al. (2008). This analysis measures the degree of exclusive ancestry on labeled groups of a rooted tree. This is done using a statistical method to estimate the accumulated genetic ancestry of a group in one or more trees, with the null hypothesis being that labeled groups form a single group of mixed genealogical ancestry. Gsi enables one to test the hypothesis of significant genealogical divergence at a given locus before monophyly is achieved, and thus allows us to see the amount of genealogical divergence between Cozumel island populations and mainland populations. If the two populations have been separated for a long period of time, the divergence between them should be high. The relative degree of ancestry is measured on a scale from 0 to 1, where 1 indicates complete monophyly. A maximum likelihood tree was computed using PhyML 3.0 web based software (Guindon, Dufayard, Lefort, Anisimova, Hordijk & Gascuel, 2010). The substitution model parameters were: HKY85 model, empirical equilibrium frequencies, estimated transition/transversion ratio, fixed proportion of invariable sites, and estimated gamma shape parameter.

If the Cozumel island populations were separated from the mainland by a single vicariant event with no subsequent dispersal from mainland source populations to the island, gene flow should have ceased at that time. We estimated $M=m/\mu$ (migration per generation) with the program IMa2 (Hey & Nielsen, 2007) which implements a Markov chain Monte Carlo coalescent approach. IMa2 was chosen due to the fact that the divergence between island and mainland could have occurred relatively recently. IMa2 is known to deal well with recently diverged populations and the analysis is robust even faced with violations of the IM model (Strasburg & Rieseberg, 2010). To obtain demographic rates for mutation rate scaled parameters, a 7.5-12% per million year substitution rate for cyt-b was used (Arbogast, Browne & Weigl, 2001). The substitution for the control region was 5.56e-8 ± 2.02e-8/year (Goios, Pereira, Bogue, Macaulay & Amorim, 2007). For IMa2 analyses, the generation time was set to 1 year, the inheritance scalar to 0.25, and the HKY model of evolution was selected. Preliminary runs were used to determine the starting values of prior distribution. For each analysis, two final runs were conducted with different random seeds, setting prior values to $m = 2$, $t = 100.88$, and $q = 300$. A geometric heating scheme was adopted using 20 chains for 50000 steps after a burn in of 1000 steps. Independent runs produced similar posterior distributions with effective sampling sizes >100 indicated that the parameters had reached stationary distribution.

RESULTS

Geometric Morphometrics

According to the paired t-test, *Reithrodontomys spectabilis* was significantly larger in size than *R. gracilis* in all three skull views. *Peromyscus* exhibited a significant size difference in only in the dorsal view of the skull, while *Oryzomys* did not differ significantly in size in any view (Table 7).

In views of both the skull and the mandible, shape varied significantly by taxon and by island/mainland location with significant interaction between the two (Table 4, Table 5, Table 6). Sex was not a significant effect within species across island/mainland. Therefore, sexes were pooled in subsequent analyses.

Reithrodontomys spectabilis is significantly different from *R. gracilis* in the dorsal view of the skull on both relative warps from island to mainland indicating dramatic changes in skull shape. *Oryzomys* differs significantly only along RW1. Island and mainland *Peromyscus* is not significantly different in either warp (Figure 5A). The main shape change in the skull is across RW1, with a shift in the zygomatic arch from point of curvature to point of greatest breadth. With RW2, of which only *Reithrodontomys* differed significantly, there is a slight shift forward in the nasal region.

In the ventral view of the skull, *Oryzomys* differed significantly in RW2, while *Reithrodontomys* and *Peromyscus* differed significantly in only RW1 (Figure 5B). Both island

Reithrodontomys and *Peromyscus* moved in the same spatial direction along RW1 compared to mainland samples. The response was similar in the dorsal view of the skull. The shape change among all three rodent skulls in RW1 can be described as a compression of the central area of the skull from mainland to island. On RW2, the toothrow on the mainland samples is more expanded than those on the island.

There were also taxon specific differences between RW1 and RW2 for the mandible. *Reithrodontomys* was significantly different in both RW1 and RW2, *Peromyscus* differed significantly in RW1, and *Oryzomys* was not significantly different in either relative warp. *Peromyscus* and *Reithrodontomys* moved in the same spatial direction from mainland to island (up and left) while *Oryzomys* moved down and left (Figure 5C). The change from mainland to island on RW1 was characterized by an elongation of the coronoid process and larger breadth of the posterior portion of the mandible. With RW2, from mainland to island, the coronoid process is shifted up and back, while the curvature of the ramus is moved toward the anterior portion of the mandible.

Molecular Analyses

In all diversity measurements, island populations of *Peromyscus leucopus* and *Reithrodontomys* exhibited significantly less diversity than their mainland counterparts. There were no significant differences between island and mainland populations of *Oryzomys* for cyt-b θ (π), and cyt-b nucleotide diversity π (Table 8).

The results of the pairwise Fst and gsi analysis indicate both *Reithrodontomys* and *Oryzomys* have less genetic structure on the island compared to the mainland (Table 9). This is in contrast to *Peromyscus leucopus* which has a higher Fst value, indicating a more structured island population. Gsi values for all island populations were higher than their mainland counterparts. *P. l. cozumelae* had an estimated gsi of 1 indicating complete monophyly. *Reithrodontomys spectabilis* had a gsi of 0.9092, indicating strong support for island monophyly. *O. c. cozumelae* had the lowest gsi estimate (0.636).

IMa2 analysis under the isolation with migration coalescence model produced well resolved marginal posterior probability distributions of all parameters. The three genera showed varying amounts of gene flow between island and mainland (Table 10). Both *Peromyscus* and *Reithrodontomys* had larger gene flow estimates going from the island to the mainland, while gene flow estimates from the mainland to the island were higher for *Oryzomys*. However, when 95% confidence intervals were included, the difference between island and mainland gene flow estimates was not significant. Likewise, 95% confidence intervals indicate there are no significant differences in gene flow estimates among the three genera.

DISCUSSION

Geometric Morphometrics

The island rule predicts that small sized mammals evolve larger sizes when isolated on an island. However, whether or not this may also affect skull and mandibular shape has not been evaluated. *Reithrodontomys spectabilis* exhibited the most dramatic shape change across all three views of the skull and mandible when compared to *R. gracilis*. The shape of the skull and mandible of *R. spectabilis* is significantly different in all three views in at least one relative warp. Both *Peromyscus* and *Oryzomys* have also experienced some shape change from mainland to island, however, both have instances wherein they have not significantly changed in shape. For example, *Oryzomys* differs from island to mainland in the skull but not mandibular shape, while

Peromyscus differs from island to mainland in the ventral view of the skull and in the shape of the mandible.

Shape change in the skulls and mandibles of isolated island rodents is a pattern that has been observed by other researchers. For example Nagorsen et al. (2003), found that marmot mandibles from Vancouver Island, British Columbia, Canada, had dramatically changed shape in a relatively short amount of time. These findings support those of Millien (2006), in which it is found that insular mammals undergo more rapid evolutionary changes in linear measurements when compared to mainland populations.

There was a difference in the direction and magnitude of the shape change within *Oryzomys* when compared with the other two rodents. In all three views, both *Peromyscus* and *Reithrodontomys* displayed a similar shift in direction and magnitude between mainland and island populations. For example, in the dorsal view, both *Reithrodontomys* and *Peromyscus* moved to the upper right quadrant with the greatest change in RW2, although the shape change in *Peromyscus* is not significant. In contrast, *Oryzomys* shifted center right with the greatest change in RW1. In the ventral view with *Reithrodontomys* and *Peromyscus* moved center right with the greatest change in RW1, while *Oryzomys* shifted lower center with the greatest change in RW2. A similar pattern is evident for the mandible in that *Reithrodontomys* and *Peromyscus* exhibited similar shape changes relative to *Oryzomys*.

Size differences between island and mainland forms seem to be linked with amount of change in the shape. The size change is significantly different for *Reithrodontomys*, marginally different for *Peromyscus* and not evident for *Oryzomys*. This follows the shape change in that island *Reithrodontomys* have changed in size the most, island *Peromyscus* are only slightly larger, and there are no significant differences between island and mainland *Oryzomys*.

In addition, it is interesting that *Reithrodontomys*, although more distinct in shape and size, shares a similar pattern of change with *Peromyscus* and not *Oryzomys*. *Reithrodontomys spectabilis* usually does not occur in the same habitat as *P. l. cozumelae* and, in fact, is more often found with *O. c. cozumelae* (Engstrom et al., 1989; Jones & Lawlor, 1965). However both *Reithrodontomys* and *Peromyscus* are more ecologically similar in terms of diet when compared to *Oryzomys* which could lead to the covarying shape change. This similar direction of change in size and shape may also be due to phylogenetic constraint because *Reithrodontomys* and *Peromyscus* share a more recent common ancestor (both are in the subfamily Neotominae) relative to *Oryzomys*, which is in the subfamily Sigmodontinae.

Molecular Analyses

Insular rodent populations often exhibit unique genetic signatures. It has been found that these isolated rodent populations generally exhibit lower levels of genetic diversity (Frankham, 1997). Often this relatively low level of genetic diversity is attributed to a founder event, population bottleneck, severely reduced level of gene flow, or a combination of these factors (Kilpatrick, 1981).For example, Abdelkrim, et al. (2005) observed that ship rats exhibited lower levels of genetic diversity on the Guadeloupe Archipelago and even lower levels on islands surrounding the main island of Guadeloupe. Our study found that two of the three Cozumel Island rodents exhibited lower levels of genetic diversity than their mainland counterparts.

Oryzomys couesi was not significantly lower in genetic diversity as estimated by two out of the six diversity measurements. An earlier study using five microsatellite loci found that

Oryzomys couesi from the island did not have lower levels of genetic diversity (Vega et al., 2007). This could indicate that *O. couesi cozumelae* has a unique evolutionary history when compared to *Reithrodontomys spectabilis* or *Peromyscus leucopus cozumelae*. However, despite this exception, generally these rodents have undergone a reduction in genetic diversity presumably due to their insular nature.

In addition to their low levels of genetic diversity, the three rodents follow another island pattern in having a distinct population structure. The Fst results from Arlequin show an Fst value significantly different from zero for all three pairs of species. This is in support of other findings, for example, *Peromyscus keeni* was found to exhibit higher levels genetic distinction when isolated in the Alexander archipelagos (Lucid & Cook, 2004).

The gsi results also support a highly structured island population. All three island species exhibited higher gsi values, indicating island populations more genetically homogeneous when compared to their mainland counterpart populations. The high gsi value estimated for *P. l. cozumelae* indicates that this form is monophyletic compared to the mainland populations. However, this result may reflect the inclusion of *P. leucopus* samples from outside the Yucatan Peninsula. *R. spectabilis* also displays a very high gsi which supports island monophyly. *O. c. cozumelae* did have a higher gsi than *O. couesi* from the mainland, but was much lower when compared to *P. l. cozumelae* and *R. spectabilis*. This indicates that *O. c. cozumelae* is in an earlier stage of lineage sorting compared to *P. l. cozumelae* and *R. spectabilis*.

Because Cozumel Island is 18 km off the coast and is separated from the mainland by a 914 m deep channel, it is expected that the island fauna have reduced or no gene flow with the mainland. The gene flow results from this analysis are inconclusive. The exact amount of gene flow may be difficult to recover due to a recent divergence event. Because gene flow varies from low to high amounts (e.g. for *Oryzomys,* lowest mainland to island measurement at 0.0, and highest measurement at 0.7410), this indicates that a potential recent divergence is causing the divergence and gene flow measurement to become entangled (Runemark, Hey, Hansson & Svensson, 2012). There may not have been enough time for gene flow to shape divergence.

CONCLUSIONS

Reithrodontomys spectabilis, *Oryzomys couesi cozumelae*, and *Peromyscus leucopus cozumelae*, have likely been separated from the Yucatan Peninsula only recently, at the longest 125,000 YBP (Spaw, 1977). Despite this relatively recent split, all three island forms have undergone changes in both size and shape of the skull and mandible and show changes in genetic structuring consistent with founder events and reduction in gene flow. *R. spectabilis* is more distinct, both genetically and morphologically, when compared to its mainland sister taxon *R. gracilis*. There is significant shape change throughout the skull and a well as a significant change in size. Genetically, *R. spectabilis* is much lower in diversity than *R. gracilis*. When *R. spectabilis* and *R. gracilis* are included in a phylogenetic analysis of *cyt-b* sequence data which included all *Reithrodontomys* species from Middle America, *R. gracilis* was rendered paraphyletic or formed an unresolved node with samples of *R. spectabilis* (Arellano et al., 2005). This means that, despite its morphological distinctness, *R. spectabilis* has not yet achieved monophyly with respect to *R. gracilis* for a relatively fast evolving gene. The gsi analyses supports this finding but also illustrates that there is a significant genealogical divergence between *R. spectabilis* and *R. gracilis* despite the fact that *R. spectabilis* is not yet monophyletic with respect to *R. gracilis*. This supports the hypothesis that *R. spectabilis* is a recent derivative of *R. gracilis*. Overall, *R. spectabilis* follows the "island rule" predictions: larger size, and less genetic diversity.

The morphological evidence presented herein supports the recognition of *Reithrodontomys spectabilis* as a distinct species on the basis of differences in both size and shape of the skull and lower mandible. This larger size and change in shape could be due to a longer separation from the mainland population. It is not surprising that a size and shape change has occurred as small mammals have been known to change in shape and size in a very short amount of time (Nagorsen & Cardini, 2009; Pergams & Lacy, 2008; Pergams & Lawler, 2009; Smith & Patton, 1988).

Peromyscus leucopus cozumelae also follows "island rule" expectations in that *P. l. cozumelae* exhibits lower genetic diversity and high genetic structure than *P. leucopus* from the mainland. There is an increase in size from island to mainland, but only in certain areas of the skull and mandible and not of the same magnitude as *R. spectabilis*. The fact that *P. leucopus* follows a similar shape trajectory as *Reithrodontomys* is intriguing as it is likely due to shared ecology or phylogenetic constraint between the two island forms (Engstrom et al., 1989).

Oryzomys couesi cozumelae seems to be the least distinct relative to its mainland counterpart and when compared with *R. spectabilis* and *P. l. cozumelae*. It experienced shape change from mainland to island, but not in the same direction or magnitude as the other two genera as there is no significant difference in size between island and mainland *O. couesi* samples. It also does not unequivocally follow the lower genetic diversity expected from island populations. This includes genetic assays from other research on microsatellites (Fuentes-Montemayor et al., 2009). *O. c. cozumelae* does not appear to conform to the "island rule."

The varying responses of these three rodents may likely be due to length of divergence Perhaps *R. spectabilis* is derived from *R. gracilis* that colonized Cozumel Island prior to the appearance of *P. l. cozumelae* and *O. c. cozumelae* with the longest date of separation being about 125,000 B.P which is the latest date of island submergence (Spaw, 1977). *Oryzomys couesi* is known to be semi aquatic and therefore, could traverse the channel between the mainland and island more effectively than either *Reithrodontomys* or *P. leucopus*. Unfortunately, the IMa2 analysis of gene flow was unable to detect significant differences in gene flow between the three groups.

Meiri (2008) proposed that the island rule does not apply as generally as previously thought. In fact, it may even be clade specific rather than size specific (Meiri et al., 2008). Our results support this conclusion. The "island rule" may be more based on each species evolutionary history rather than a general rule. This is the first study that has compared three different taxa isolated on this same island. The response to isolation was different for all three lineages in term of both morphology and genetic composition. Only *R. spectabilis* followed the island rule of greater size while *P. l. cozumelae* and *O. c. cozumelae* did not. These findings are in line with the findings of Meiri et al. (2008) in which evolution on islands is highly conditional on the history, community composition, and biology of the colonizing species.

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TABLES

Table 1 – Definition and numbering of dorsal cranial landmarks

Landmark 1	Anterior tip of the nasals
Landmark 2	Posterior suture of the nasals with the midline
Landmark 3	Suture of the midline with posterior suture of the frontals
Landmark 4	Point of contact with midline and anterior portion of the interparietal
Landmark 5	Level with the midline, the posterior suture of the interparietal
Landmark 6	Furthest point of curvature of the skull
Landmark 7	Posterior contact of squamosal and parietal
Landmark 8	Point of entry of zygomatic arch
Landmark 9	Greatest breadth of zygomatic arch
Landmark 10	Interorbital constriction
Landmark 11	Slope at anterior portion of zygomatic arch
Landmark 12	Zygomatic notch
Landmark 13	Anterior contact of nasals and premaxillaries

Table 2 – Definition and numbering of ventral cranial landmarks

Landmark 1	Anterior tip of the nasals
Landmark 2	Anterior sagittal intersection of the incisive alveola
Landmark 3	Anterior end of the incisive foramen
Landmark 4	Posterior end of the incisive foramen
Landmark 5	Posterior end of the suture of the palatines
Landmark 6	Level with the midline, the suture of the occipital and basisphenoid
Landmark 7	Anterior limit of the foramen magnum
Landmark 8	Most posterior point on the occipital
Landmark 9	Furthest point of curvature of the skull
Landmark 10	Insertion of the auditory meatus
Landmark 11	Tip of the Eustachian tube
Landmark 12	Point of entry of zygomatic arch
Landmark 13	Greatest breadth of zygomatic arch
Landmark 14	Slope at anterior portion of zygomatic arch
Landmark 15	Anterior most protuberance of the maxillary
Landmark 16	Anterior extremity of the toothrow
Landmark 17	Posterior extremity of the toothrow
Landmark 18	Upper extremity of the toothrow
Landmark 19	Lower extremity of the toothrow

Table 3 – Definition and numbering of mandibular landmarks

Landmark 1	Upper extreme anterior part of the incisor alveolus
Landmark 2	Anterior extremity of the maxillary toothrow
Landmark 3	Anterior point of curvature of the coronoid process
Landmark 4	Tip of the coronoid process
Landmark 5	Sigmoid notch
Landmark 6	Anterior tip of the condyle
Landmark 7	Tip of the condyle
Landmark 8	Posterior tip of the condyle
Landmark 9	Greatest curvature point between angular process and posterior tip of the condyle
Landmark 10	Posterior extremity of the angular process
Landmark 11	Greatest point of curvature of the ramus
Landmark 12	Lower extreme posterior part of the incisor alveolus

Table 4 – Results of the multivariate mixed model analysis for the dorsal view of the skull.

Effect	*F.*	d.f.	*P.*
Sex	0.04	1, 2219	0.8379
Index variable	6.61	14, 1639	< 0.0001
Sex x Index variable	1.65	14, 1639	0.0602
Species	134.33	2, 2219	< 0.0001
Species x Index variable	72.55	28, 2298	< 0.0001
Island/Mainland	24.95	1, 2219	< 0.0001
Island/Mainland x Index variable	4.17	14, 1639	< 0.0001
Sex x Species	1.04	2, 2219	0.3535
Sex x Species x Index variable	1.10	28, 2298	0.3272
Sex x Island/Mainland	0.05	1, 2219	0.8180
Sex x Island/Mainland x Index variable	0.73	14, 1639	0.7504
Species x Island/Mainland	18.62	2, 2219	< 0.0001
Species x Island/Mainland x Index variable	8.94	28, 2298	< 0.0001
Sex x Island/Mainland x Species	0.00	2, 2219	0.9961
Sex x Island/Mainland x Species x Index variable	0.80	28, 2298	0.7586
Centroid size	3.23	1, 2219	0.0723
Centroid size x Index variable	11.59	14, 1639	< 0.0001

Table 5 – Results of the multivariate mixed model analysis for the ventral view of the skull

Effect	*F.*	d.f.	*P.*
Sex	0.63	1, 2420	0.4287
Index variable	14.58	14, 1500	< 0.0001
Sex x Index variable	1.02	14, 1500	0.4266
Species	76.22	2, 2420	< 0.0001
Species x Index variable	32.99	28, 2102	< 0.0001
Island/Mainland	8.84	1, 2420	0.0030
Island/Mainland x Index variable	7.04	14, 1500	< 0.0001
Sex x Species	0.94	2, 2420	0.3921
Sex x Species x Index variable	0.93	28, 2102	0.5653
Sex x Island/Mainland	0.22	1, 2420	0.6369
Sex x Island/Mainland x Index variable	0.89	14, 1500	0.5643
Species x Island/Mainland	6.64	2, 2420	0.0013
Species x Island/Mainland x Index variable	7.25	28, 2102	< 0.0001
Sex x Island/Mainland x Species	0.21	2, 2420	0.8081
Sex x Island/Mainland x Species x Index variable	0.86	28, 2102	0.6701
Centroid size	21.94	1, 2420	< 0.0001
Centroid size x Index variable	15.14	14, 1500	< 0.0001

Table 6 – Results of the multivariate mixed model analysis for the mandible view.

Effect	*F.*	d.f.	*P.*
Sex	0.88	1, 2100	0.3496
Index variable	10.29	11, 1232	< 0.0001
Sex x Index variable	1.51	11, 1232	0.1228
Species	116.06	2, 2100	< 0.0001
Species x Index variable	41.72	22, 1700	< 0.0001
Island/Mainland	1.18	1, 2100	0.2782
Island/Mainland x Index variable	6.77	11, 1232	< 0.0001
Sex x Species	0.23	2, 2100	0.7919
Sex x Species x Index variable	1.46	22, 1700	0.0786
Sex x Island/Mainland	2.63	1, 2100	0.1052
Sex x Island/Mainland x Index variable	0.68	11, 1232	0.7573
Species x Island/Mainland	3.04	2, 2100	0.0478
Species x Island/Mainland x Index variable	5.28	22, 1700	< 0.0001
Sex x Island/Mainland x Species	0.60	2, 2100	0.5506
Sex x Island/Mainland x Species x Index variable	1.50	22, 1700	0.0639
Centroid size	28.85	1, 2100	< 0.0001
Centroid size x Index variable	10.23	11, 1232	< 0.0001

Table 7 – Results of the paired t test on centroid size by species

	Dorsal			Ventral			Mandible		
	p value	DF	T	p value	DF	T	p value	DF	T
Reithrodontomys	0.0001	92	12.7464	0.0001	83	7.8718	0.0001	86	8.5431
Oryzomys	0.0915	95	1.7050	0.6207	91	0.4965	0.0774	92	12.7464
Peromyscus	0.0001	115	7.9253	0.5233	103	0.6404	0.4264	106	0.7984

Table 8 – Summary diversity estimates of θ (S) (Watterson, 1975), θ (π) (Tajima, 1983), and nucleotide diversity π (Tajima, 1993) and their 95% confidence intervals for Cytochrome b (Cytb) and the control region (CR) from Arlequin v. 3.5.1.2 (Excoffier et al., 2005) All values are statistically significant except those indicated by *.

		θ S		θ π		nucleotide diversity π	
		Cytb	*CR*	*Cytb*	*CR*	*Cytb*	*CR*
Reithrodontomys	Island	4.522102 ± 1.644104	6.188139 ± 2.136509	2.193457 ± 1.378374	4.611664 ± 2.571374	0.007435 ± 0.004672	0.025763 ± 0.014365
	Mainland	65.345282 ± 18.407759	38.981841 ± 11.129249	22.147163 ± 11.021753	16.865248 ± 8.476017	0.075075 ± 0.037362	0.094219 ± 0.047352
Oryzomys	Island	4.237335 ± 1.680623	6.426922 ± 2.408488	* 3.646667 ± 2.129094	6.358696 ± 3.481255	* 0.049954 ± 0.029166	0.019809 ± 0.010845
	Mainland	13.494295 ± 3.589257	61.495428 ± 15.092702	* 8.391287 ± 4.337986	146.332079 ± 70.034257	* 0.114949 ± 0.059424	0.455863 ± 0.218175
Peromyscus	Island	4.17593 ± 1.403968	3.131947 ± 1.123119	1.061457 ± 0.788921	1.043459 ± 0.779449	0.006207 ± 0.004614	0.00509 ± 0.003802
	Mainland	55.497265 ± 22.658594	67.869266 ± 27.628822	73.755556 ± 39.342633	95.711111 ± 50.940343	0.431319 ± 0.230074	0.449348 ± 0.239157

Table 9 – Results of the Fst calculation from Arlequin v. 3.5.1.2 (Excoffier et al., 2005) for Cytochrome b (Cytb) and the control region (CR) and the gsi estimates for the island and mainland (Cummings et al., 2008). All values are statistically significant from zero

	Fst		gsi	
	Cytb	CR	Island	Mainland
Reithrodontomys	0.31375	0.32303	0.9092	0.7849
Oryzomys	0.27822	0.32567	0.636	0.1322
Peromyscus	0.67460	0.63683	1	0.8868

Table 10 – Results of the IMa2 analyses estimating gene flow between island and mainland. M0 > 1 indicates M = m/μ from island to mainland forward in time. M1 > 0 indicates M=m/μ from mainland to island forward in time. 95% confidence intervals are included in parentheses.

	M0 > 1	M1 > 0
Reithrodontomys	0.07652 (0.009000, 0.1550)	0.03917 (0.0, 0.08300)
Oryzomys	0.1466 (0.02100, 0.2650)	0.2726 (0.0, 0.7410)
Peromyscus	0.2043 (0.01300, 0.4890)	0.04368 (0.0, 0.1310)

FIGURES

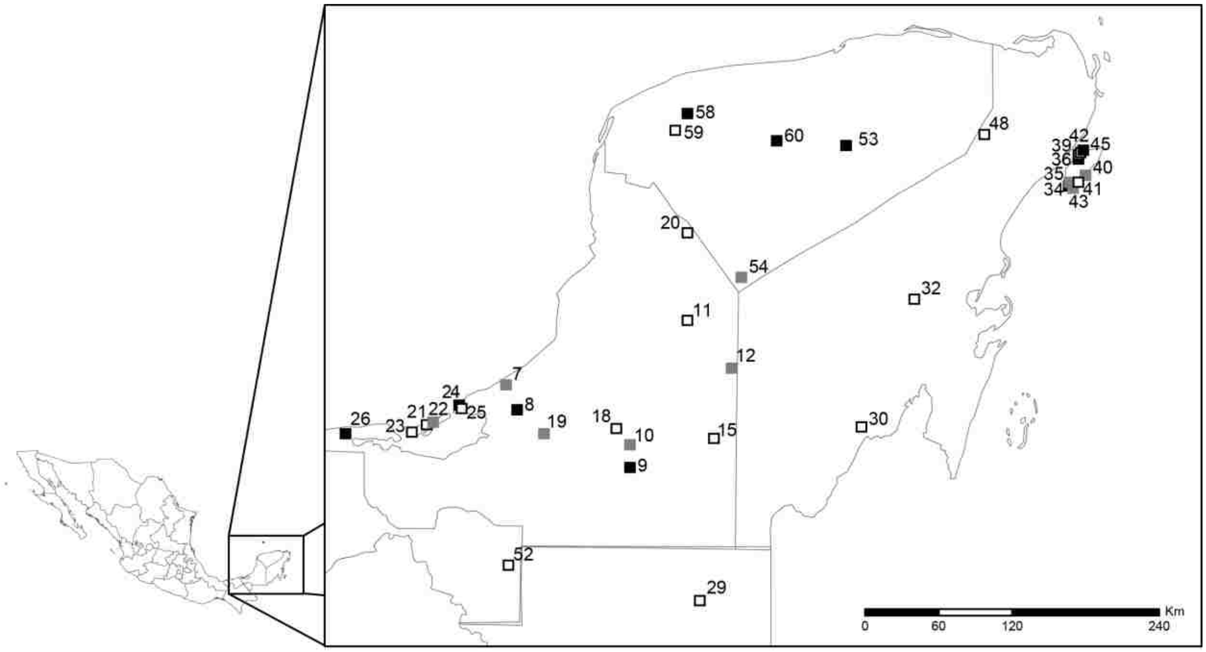

Figure 1 – Collection localities of *Reithrodontomys gracilis* and *R. spectabilis*. Black squares indicate a tissue sample, open squares indicate a skull/mandible sample, and grey squares are localities where both a tissue and skull/mandible samples were taken. Numbers indicate the numbered localities in Appendix 1

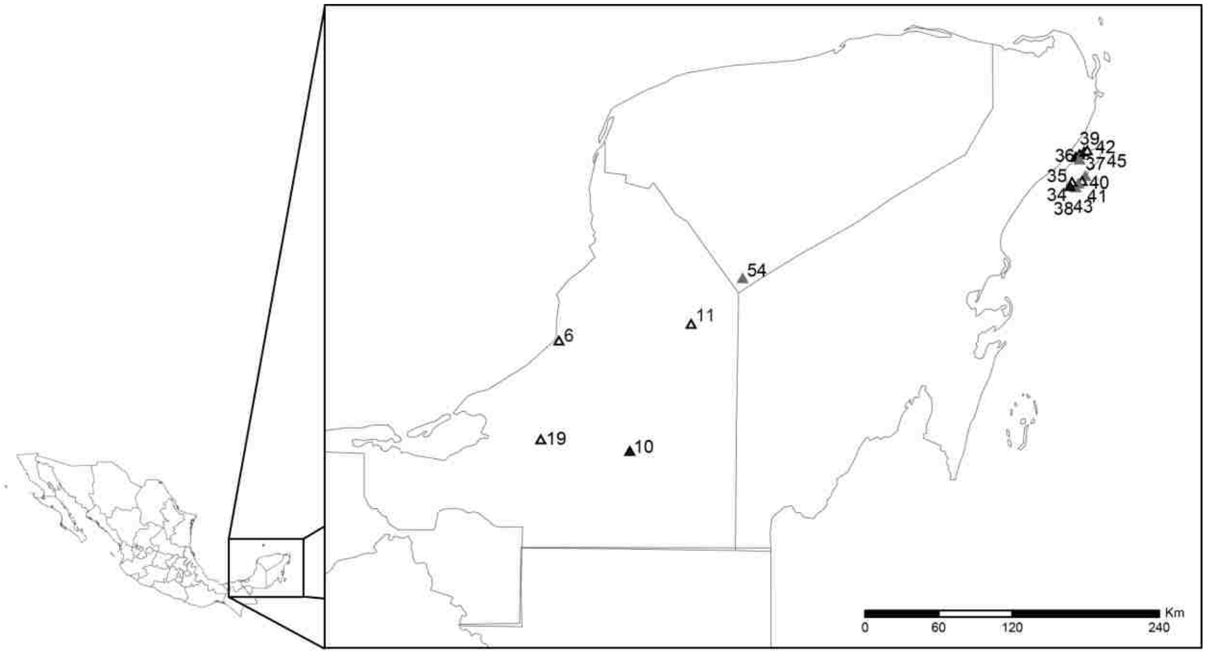

Figure 2 – Collection localities of *Peromyscus leucopus*. Black triangles indicate a tissue sample, open triangles indicate a skull/mandible sample, and grey triangles are localities where both a tissue and skull/mandible samples were taken. Numbers indicate the numbered localities in Appendix 1

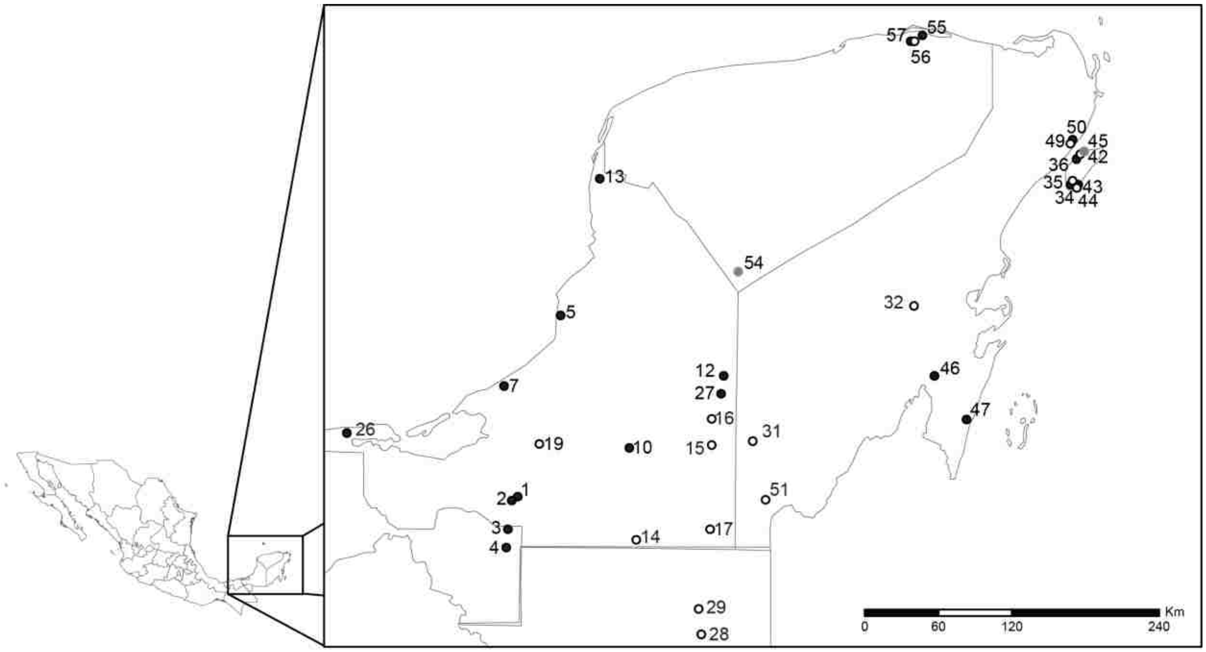

Figure 3 – Collection localities of *Oryzomys couesi*. Black circles indicate a tissue sample, open circles indicate a skull/mandible sample, and grey circles are localities where both a tissue and skull/mandible samples were taken. Numbers indicate the numbered localities in Appendix 1

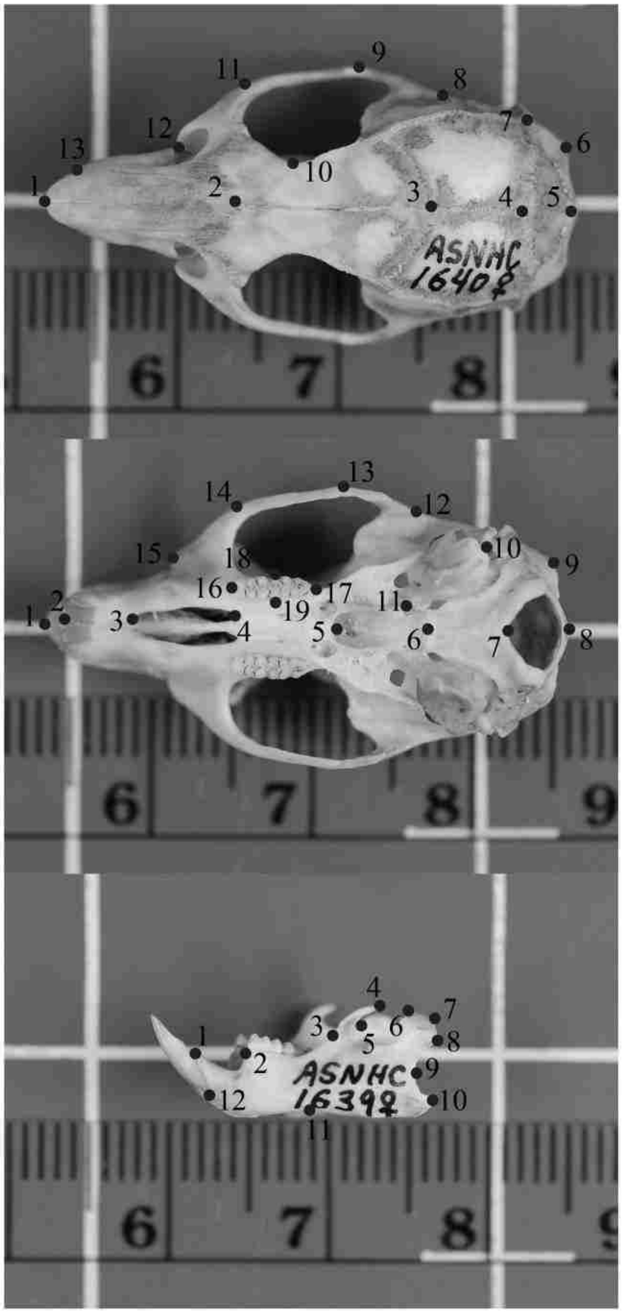

Figure 4 – A. (top) Landmarks for the dorsal view of the skull B. (center) Landmarks for the ventral view of the skull C. (bottom) Landmarks for the mandible

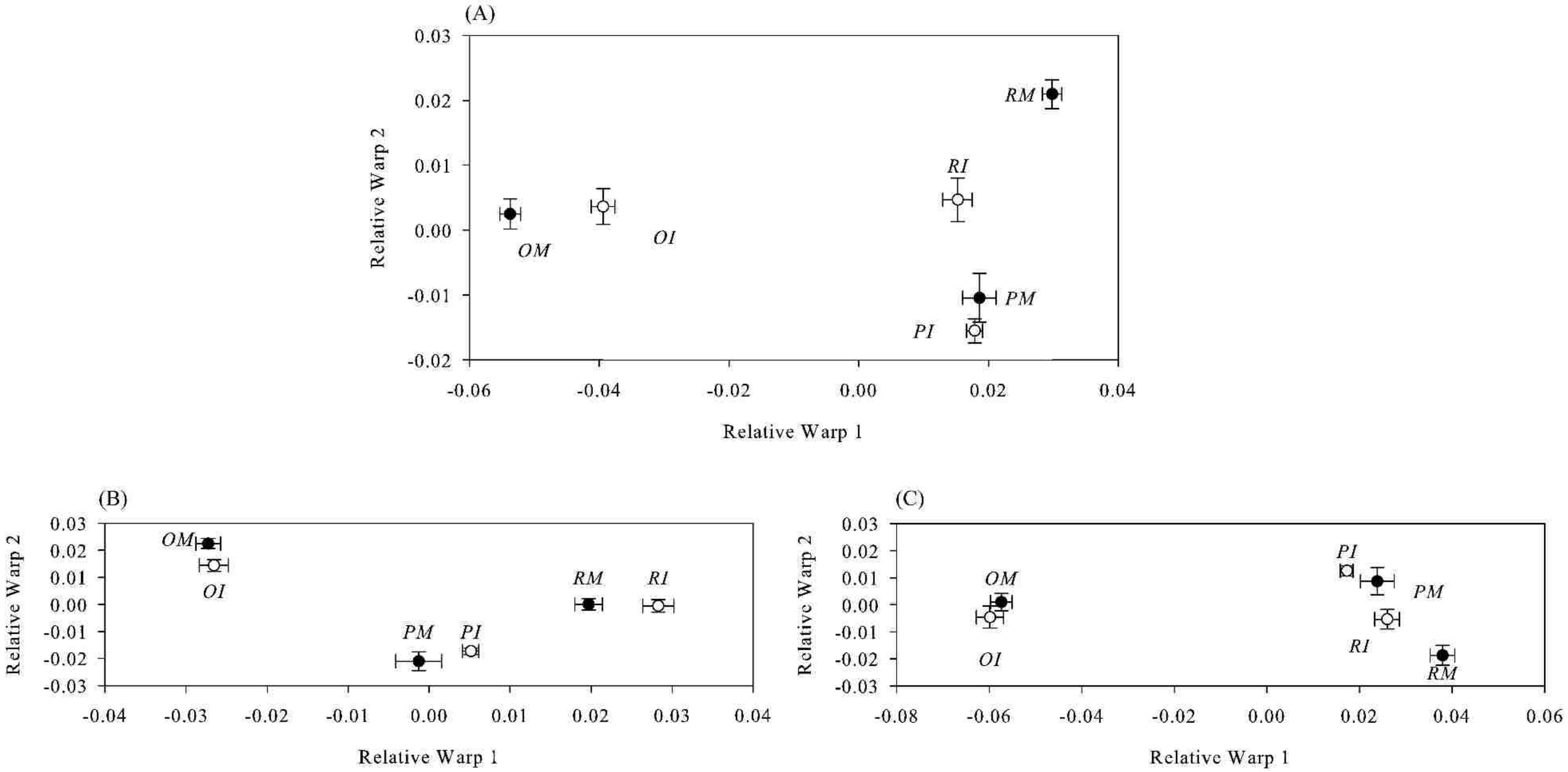

Figure 5 – Scatter plot of relative warp 1 plotted against relative warp 2 for the dorsal view of the skull (A), ventral view of the skull (B), and mandible (C) with standard error bars included. O represents *Oryzomys*, P represents *Peromyscus*, R represents *Reithrodontomys*, M represents mainland, and I represents island.

APPENDIX I

List of tissue and skull samples included in this study with locality number, collecting location and collector/museum number.

Genus/species	Cat number	State	Locality	Locality number	Type
Oryzomys couesi	ASK2506	Campeche	Candelaria, 10 km S of	1	T
Oryzomys couesi	ASK2507	Campeche	Candelaria, 10 km S of	1	T
Oryzomys couesi	ASK2508	Campeche	Candelaria, 10 km S of	1	T
Oryzomys couesi	ASK2504	Campeche	Candelaria, 11 km S of	2	T
Oryzomys couesi	ASK0210	Campeche	Candelaria, 27 km S of	3	T
Oryzomys couesi	ASK0211	Campeche	Candelaria, 27 km S of	3	T
Oryzomys couesi	ASK2512	Campeche	Candelaria, 39 km S of	4	T
Oryzomys couesi	ASK2513	Campeche	Candelaria, 39 km S of	4	T
Oryzomys couesi	FN29759	Campeche	Champoton, 16 km N of	5	T
Oryzomys couesi	FN29760	Campeche	Champoton, 16 km N of	5	T
Oryzomys couesi	FN29761	Campeche	Champoton, 16 km N of	5	T
Oryzomys couesi	FN29762	Campeche	Champoton, 16 km N of	5	T
Oryzomys couesi	FN29763	Campeche	Champoton, 16 km N of	5	T
Oryzomys couesi	FN29764	Campeche	Champoton, 16 km N of	5	T
Oryzomys couesi	FN29765	Campeche	Champoton, 16 km N of	5	T
Oryzomys couesi	FN29766	Campeche	Champoton, 16 km N of	5	T
Oryzomys couesi	FN29767	Campeche	Champoton, 16 km N of	5	T
Oryzomys couesi	FN29768	Campeche	Champoton, 16 km N of	5	T
Oryzomys couesi	FN29769	Campeche	Champoton, 16 km N of	5	T
Oryzomys couesi	FN29770	Campeche	Champoton, 16 km N of	5	T
Oryzomys couesi	FN29771	Campeche	Champoton, 16 km N of	5	T
Oryzomys couesi	FN29772	Campeche	Champoton, 16 km N of	5	T
Oryzomys couesi	FN29773	Campeche	Champoton, 16 km N of	5	T
Oryzomys couesi	FN29774	Campeche	Champoton, 16 km N of	5	T

Oryzomys couesi	FN29775	Campeche	Champoton, 16 km N of	5	T
Oryzomys couesi	FN29776	Campeche	Champoton, 16 km N of	5	T
Oryzomys couesi	FN29777	Campeche	Champoton, 16 km N of	5	T
Oryzomys couesi	FN29665	Campeche	Champoton, 52 km SW of	7	T
Oryzomys couesi	FN29666	Campeche	Champoton, 52 km SW of	7	T
Oryzomys couesi	FN29669	Campeche	Champoton, 52 km SW of	7	T
Oryzomys couesi	FN29670	Campeche	Champoton, 52 km SW of	7	T
Oryzomys couesi	FN29673	Campeche	Champoton, 52 km SW of	7	T
Oryzomys couesi	FN29674	Campeche	Champoton, 52 km SW of	7	T
Oryzomys couesi	FN29675	Campeche	Champoton, 52 km SW of	7	T
Oryzomys couesi	FN29676	Campeche	Champoton, 52 km SW of	7	T
Oryzomys couesi	FN29677	Campeche	Champoton, 52 km SW of	7	T
Oryzomys couesi	FN29678	Campeche	Champoton, 52 km SW of	7	T
Oryzomys couesi	FN29679	Campeche	Champoton, 52 km SW of	7	T
Oryzomys couesi	FN29680	Campeche	Champoton, 52 km SW of	7	T
Oryzomys couesi	FN29730	Campeche	Champoton, 52 km SW of	7	T
Oryzomys couesi	FN29667	Campeche	Champoton, 52 km SW of	7	T
Oryzomys couesi	FN29668	Campeche	Champoton, 52 km SW of	7	T
Oryzomys couesi	ASK2554	Campeche	Constitucion (9.5 km S of), Escarcega (9.5 km S 70 km E)	10	T
Oryzomys couesi	ASK2555	Campeche	Constitucion (9.5 km S of), Escarcega (9.5 km S 70 km E)	10	T
Oryzomys couesi	ASK2568	Campeche	Constitucion (9.5 km S of), Escarcega (9.5 km S 70 km E)	10	T
Oryzomys couesi	ASK2569	Campeche	Constitucion (9.5 km S of), Escarcega (9.5 km S 70 km E)	10	T
Oryzomys couesi	ASK2617	Campeche	Constitucion (9.5 km S of), Escarcega (9.5 km S 70 km E)	10	T
Oryzomys couesi	FN30495	Campeche	Dzibalchen, 60 km SE of	12	T
Oryzomys couesi	FN30555	Campeche	Dzibalchen, 60 km SE of	12	T
Oryzomys couesi	FN30590	Campeche	Dzibalchen, 60 km SE of	12	T

Oryzomys couesi	FN32792	Campeche	El Remata, 14 km W of Tanuche	13	T
Oryzomys couesi	KU93661	Campeche	Escarcega, 103 km SE of	14	SK
Oryzomys couesi	KU93662	Campeche	Escarcega, 103 km SE of	14	SK
Oryzomys couesi	KU93663	Campeche	Escarcega, 103 km SE of	14	SK
Oryzomys couesi	KU93664	Campeche	Escarcega, 103 km SE of	14	SK
Oryzomys couesi	KU93665	Campeche	Escarcega, 103 km SE of	14	SK
Oryzomys couesi	KU93666	Campeche	Escarcega, 103 km SE of	14	SK
Oryzomys couesi	KU93670	Campeche	Escarcega, 103 km SE of	14	SK
Oryzomys couesi	KU93671	Campeche	Escarcega, 103 km SE of	14	SK
Oryzomys couesi	KU93672	Campeche	Escarcega, 103 km SE of	14	SK
Oryzomys couesi	KU93676	Campeche	Escarcega, 103 km SE of	14	SK
Oryzomys couesi	KU93707	Campeche	Escarcega, 103 km SE of	14	SK
Oryzomys couesi	KU93658	Campeche	Escarcega, 128 km E of	15	SK
Oryzomys couesi	KU93660	Campeche	Escarcega, 128 km E of	15	SK
Oryzomys couesi	KU93706	Campeche	Escarcega, 128 km E of	15	SK
Oryzomys couesi	KU93654	Campeche	Escarcega, 20 km N, 128 km E of	16	SK
Oryzomys couesi	KU93655	Campeche	Escarcega, 20 km N, 128 km E of	16	SK
Oryzomys couesi	KU93678	Campeche	Escarcega, 65 km S, 128 km E of	17	SK
Oryzomys couesi	KU92250	Campeche	Escarcega, 7.5 km W of	19	SK
Oryzomys couesi	FN29012	Campeche	La Valeta	26	T
Oryzomys couesi	FN29013	Campeche	La Valeta	26	T
Oryzomys couesi	FN29014	Campeche	La Valeta	26	T
Oryzomys couesi	FN30658	Campeche	X-kanha, 18 km S of	27	T
Oryzomys couesi	KU65110	Peten	Tikal	28	SK
Oryzomys couesi	KU65112	Peten	Tikal	28	SK
Oryzomys couesi	KU65113	Peten	Tikal	28	SK
Oryzomys couesi	KU65109	Peten	Uaxactun	29	SK
Oryzomys couesi	KU93653	Quintana roo	Chetumal, 83 km W of	31	SK

Oryzomys couesi	KU92233	Quintana roo	Felipe Carrillo Puerto, 4 km NNE of	32	SK
Oryzomys couesi	FN32954	Quintana roo	Isla Cozumel, El Cedral	34	T
Oryzomys couesi	FN32955	Quintana roo	Isla Cozumel, El Cedral	34	T
Oryzomys couesi	FN32956	Quintana roo	Isla Cozumel, El Cedral	34	T
Oryzomys couesi	ASNHC7176	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK
Oryzomys couesi	ASNHC7178	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK
Oryzomys couesi	FN32992	Quintana roo	Isla Cozumel, San Miguel	36	T
Oryzomys couesi	FN32993	Quintana roo	Isla Cozumel, San Miguel	36	T
Oryzomys couesi	FN32994	Quintana roo	Isla Cozumel, San Miguel	36	T
Oryzomys couesi	FN32995	Quintana roo	Isla Cozumel, San Miguel	36	T
Oryzomys couesi	FN32996	Quintana roo	Isla Cozumel, San Miguel	36	T
Oryzomys couesi	FN32997	Quintana roo	Isla Cozumel, San Miguel	36	T
Oryzomys couesi	FN32998	Quintana roo	Isla Cozumel, San Miguel	36	T
Oryzomys couesi	KU92168	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92169	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92170	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK

Oryzomys couesi	KU92171	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92172	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92175	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92176	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92177	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92178	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92179	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92180	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92181	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92182	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92183	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92184	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92187	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92188	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92190	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92191	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK

Oryzomys couesi	KU92192	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92193	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92194	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92195	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92199	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92200	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92201	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	KU92202	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Oryzomys couesi	ASNHC7177	Quintana roo	Isla Cozumel, San Miguel, 30 km SE	43	SK
Oryzomys couesi	ASNHC7180	Quintana roo	Isla Cozumel, San Miguel, 30 km SE	43	SK
Oryzomys couesi	ASNHC7181	Quintana roo	Isla Cozumel, San Miguel, 30 km SE	43	SK
Oryzomys couesi	ASNHC1646	Quintana roo	Isla Cozumel, San Miguel, 30 km SE	43	SK
Oryzomys couesi	ASNHC1647	Quintana roo	Isla Cozumel, San Miguel, 30 km SE	43	SK
Oryzomys couesi	ASNHC1648	Quintana roo	Isla Cozumel, San Miguel, 30 km SE	43	SK
Oryzomys couesi	ASNHC1649	Quintana roo	Isla Cozumel, San Miguel, 30 km SE	43	SK
Oryzomys couesi	ASNHC1650	Quintana roo	Isla Cozumel, San Miguel, 30 km SE	43	SK

Oryzomys couesi	ASNHC1644	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Oryzomys couesi	ASNHC1645	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Oryzomys couesi	ASNHC7186	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Oryzomys couesi	ASK0582	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Oryzomys couesi	ASK0532	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Oryzomys couesi	ASK0533	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Oryzomys couesi	ASK0534	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Oryzomys couesi	ASK0535	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Oryzomys couesi	ASK0536	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Oryzomys couesi	ASK0537	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Oryzomys couesi	ASNHC7179	Quintana roo	Isla Cozumel, San Miguel, 32 km SE	44	SK
Oryzomys couesi	ASNHC1639	Quintana roo	Isla Cozumel, San Miguel, 7 km N	45	SK
Oryzomys couesi	ASNHC1640	Quintana roo	Isla Cozumel, San Miguel, 7 km N	45	SK
Oryzomys couesi	ASNHC1641	Quintana roo	Isla Cozumel, San Miguel, 7 km N	45	SK
Oryzomys couesi	ASNHC1642	Quintana roo	Isla Cozumel, San Miguel, 7 km N	45	SK
Oryzomys couesi	ASNHC1643	Quintana roo	Isla Cozumel, San Miguel, 7 km N	45	SK

Oryzomys couesi	ASK0578	Quintana roo	Isla Cozumel, San Miguel, 7 km N of	45	T
Oryzomys couesi	ASK0579	Quintana roo	Isla Cozumel, San Miguel, 7 km N of	45	T
Oryzomys couesi	ASK0538	Quintana roo	Isla Cozumel, San Miguel, 7 km N of	45	T
Oryzomys couesi	ASK0539	Quintana roo	Isla Cozumel, San Miguel, 7 km N of	45	T
Oryzomys couesi	ASK0540	Quintana roo	Isla Cozumel, San Miguel, 7 km N of	45	T
Oryzomys couesi	ASK0541	Quintana roo	Isla Cozumel, San Miguel, 7 km N of	45	T
Oryzomys couesi	ASK0502	Quintana roo	Isla Cozumel, San Miguel, 7 km N of	45	T
Oryzomys couesi	ASNHC7173	Quintana roo	Kohunlich	?	SK
Oryzomys couesi	FN30912	Quintana roo	Limones, 4 km S, 16 km E	46	T
Oryzomys couesi	FN30913	Quintana roo	Limones, 4 km S, 16 km E	46	T
Oryzomys couesi	FN30911	Quintana roo	Majahual, 6 km S of	47	T
Oryzomys couesi	ASNHC7174	Quintana roo	Puerto Morales, 2 km S, 2.5 km W	49	SK
Oryzomys couesi	ASNHC7175	Quintana roo	Puerto Morales, 2 km S, 2.5 km W	49	SK
Oryzomys couesi	FN29980	Quintana roo	Puerto Morelos, 1 km W of	50	T
Oryzomys couesi	FN29981	Quintana roo	Puerto Morelos, 1 km W of	50	T
Oryzomys couesi	FN29982	Quintana roo	Puerto Morelos, 1 km W of	50	T

Oryzomys couesi	FN29983	Quintana roo	Puerto Morelos, 1 km W of	50	T
Oryzomys couesi	FN29984	Quintana roo	Puerto Morelos, 1 km W of	50	T
Oryzomys couesi	FN29985	Quintana roo	Puerto Morelos, 1 km W of	50	T
Oryzomys couesi	ASNHC7187	Quintana roo	Tres Garantias, 6 km S, 1.5 km W	51	SK
Oryzomys couesi	ASNHC7188	Quintana roo	Tres Garantias, 6 km S, 1.5 km W	51	SK
Oryzomys couesi	ASNHC6252	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6253	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6254	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6255	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6256	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6257	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6258	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6259	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6260	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6261	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6262	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6263	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6264	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6265	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6266	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6267	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6268	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6269	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6270	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6271	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6272	Yucatan	Laguna Becanchen	54	SK

Oryzomys couesi	ASNHC6273	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6274	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6275	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6276	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6277	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	ASNHC6280	Yucatan	Laguna Becanchen	54	SK
Oryzomys couesi	FN30396	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30341	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30342	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30343	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30344	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30345	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30346	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30347	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30348	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30349	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30350	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30351	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30352	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30353	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30354	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30355	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30356	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30357	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30358	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30359	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30360	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30361	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30362	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30363	Yucatan	Laguna Becanchen	54	T

Oryzomys couesi	FN30364	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30365	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30366	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30390	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30391	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30392	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30393	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30394	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30395	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30396	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30397	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30398	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN30427	Yucatan	Laguna Becanchen	54	T
Oryzomys couesi	FN32865	Yucatan	Las Coloradas	55	T
Oryzomys couesi	FN32866	Yucatan	Las Coloradas	55	T
Oryzomys couesi	FN32867	Yucatan	Las Coloradas	55	T
Oryzomys couesi	ASNHC7194	Yucatan	Las Coloradas, 5 km S, 5 km W	56	SK
Oryzomys couesi	ASNHC7195	Yucatan	Las Coloradas, 5 km S, 5 km W	56	SK
Oryzomys couesi	ASNHC7196	Yucatan	Las Coloradas, 5 km S, 5 km W	56	SK
Oryzomys couesi	FN32866	Yucatan	Las coradas, 5 km S of 6 km W of	57	T
Peromyscus leucopus	KU92395	Campeche	Champoton, 5 km S of	6	SK
Peromyscus leucopus	KU92396	Campeche	Champoton, 5 km S of	6	SK
Peromyscus leucopus	KU92397	Campeche	Champoton, 5 km S of	6	SK
Peromyscus leucopus	ASK2567	Campeche	Constitucion (9.5 km S of), Escarcega (9.5 km S 70 km E)	10	T
Peromyscus leucopus	KU95098	Campeche	Dzibalchen	11	SK
Peromyscus leucopus	KU96895	Campeche	Dzibalchen	11	SK
Peromyscus leucopus	KU96896	Campeche	Dzibalchen	11	SK
Peromyscus leucopus	KU92398	Campeche	Escarcega, 7.5 km W of	19	SK
Peromyscus leucopus	KU92399	Campeche	Escarcega, 7.5 km W of	19	SK

Peromyscus leucopus	KU92400	Campeche	Escarcega, 7.5 km W of	19	SK
Peromyscus leucopus	KU92401	Campeche	Escarcega, 7.5 km W of	19	SK
Peromyscus leucopus	KU92402	Campeche	Escarcega, 7.5 km W of	19	SK
Peromyscus leucopus	KU92404	Campeche	Escarcega, 7.5 km W of	19	SK
Peromyscus leucopus	KU92406	Campeche	Escarcega, 7.5 km W of	19	SK
Peromyscus leucopus	KU92407	Campeche	Escarcega, 7.5 km W of	19	SK
Peromyscus leucopus	KU92412	Campeche	Escarcega, 7.5 km W of	19	SK
Peromyscus leucopus	KU92414	Campeche	Escarcega, 7.5 km W of	19	SK
Peromyscus leucopus	KU92415	Campeche	Escarcega, 7.5 km W of	19	SK
Peromyscus leucopus	KU92416	Campeche	Escarcega, 7.5 km W of	19	SK
Peromyscus leucopus	FN32965	Quintana roo	Isla Cozumel, El Cedral	34	T
Peromyscus leucopus	FN32966	Quintana roo	Isla Cozumel, El Cedral	34	T
Peromyscus leucopus	FN32967	Quintana roo	Isla Cozumel, El Cedral	34	T
Peromyscus leucopus	FN32968	Quintana roo	Isla Cozumel, El Cedral	34	T
Peromyscus leucopus	FN32969	Quintana roo	Isla Cozumel, El Cedral	34	T
Peromyscus leucopus	FN32970	Quintana roo	Isla Cozumel, El Cedral	34	T
Peromyscus leucopus	FN32971	Quintana roo	Isla Cozumel, El Cedral	34	T
Peromyscus leucopus	FN32972	Quintana roo	Isla Cozumel, El Cedral	34	T
Peromyscus leucopus	FN32973	Quintana roo	Isla Cozumel, El Cedral	34	T
Peromyscus leucopus	FN32974	Quintana roo	Isla Cozumel, El Cedral	34	T
Peromyscus leucopus	FN32975	Quintana roo	Isla Cozumel, El Cedral	34	T

Peromyscus leucopus	FN32976	Quintana roo	Isla Cozumel, El Cedral	34	T
Peromyscus leucopus	FN32977	Quintana roo	Isla Cozumel, El Cedral	34	T
Peromyscus leucopus	FN32978	Quintana roo	Isla Cozumel, El Cedral	34	T
Peromyscus leucopus	ASNHC7279	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK
Peromyscus leucopus	ASNHC7281	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK
Peromyscus leucopus	ASNHC7282	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK
Peromyscus leucopus	ASNHC7284	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK
Peromyscus leucopus	ASNHC7285	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK
Peromyscus leucopus	ASNHC7286	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK
Peromyscus leucopus	ASNHC7288	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK
Peromyscus leucopus	ASNHC7289	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK
Peromyscus leucopus	ASNHC7290	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK
Peromyscus leucopus	ASNHC7291	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK
Peromyscus leucopus	ASNHC7292	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK
Peromyscus leucopus	ASNHC7293	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK
Peromyscus leucopus	ASNHC7300	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK

Peromyscus leucopus	ASNHC7301	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK
Peromyscus leucopus	ASNHC7283	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK
Peromyscus leucopus	ASNHC7287	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK
Peromyscus leucopus	ASNHC7302	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK
Peromyscus leucopus	FN32980	Quintana roo	Isla Cozumel, San Miguel	36	T
Peromyscus leucopus	FN32981	Quintana roo	Isla Cozumel, San Miguel	36	T
Peromyscus leucopus	FN32982	Quintana roo	Isla Cozumel, San Miguel	36	T
Peromyscus leucopus	FN32983	Quintana roo	Isla Cozumel, San Miguel	36	T
Peromyscus leucopus	FN32984	Quintana roo	Isla Cozumel, San Miguel	36	T
Peromyscus leucopus	FN32985	Quintana roo	Isla Cozumel, San Miguel	36	T
Peromyscus leucopus	ASK458	Quintana roo	Isla Cozumel, San Miguel	36	T
Peromyscus leucopus	ASK459	Quintana roo	Isla Cozumel, San Miguel	36	T
Peromyscus leucopus	ASK461	Quintana roo	Isla Cozumel, San Miguel	36	T
Peromyscus leucopus	ASK462	Quintana roo	Isla Cozumel, San Miguel	36	T
Peromyscus leucopus	ASK0475	Quintana roo	Isla Cozumel, San Miguel, 1 km S of 1 km E of	37	T
Peromyscus leucopus	ASK0476	Quintana roo	Isla Cozumel, San Miguel, 1 km S of 1 km E of	37	T

Peromyscus leucopus	ASK0477	Quintana roo	Isla Cozumel, San Miguel, 1 km S of 1 km E of	37	T
Peromyscus leucopus	ASK0478	Quintana roo	Isla Cozumel, San Miguel, 1 km S of 1 km E of	37	T
Peromyscus leucopus	ASK0479	Quintana roo	Isla Cozumel, San Miguel, 1 km S of 1 km E of	37	T
Peromyscus leucopus	ASK0480	Quintana roo	Isla Cozumel, San Miguel, 1 km S of 1 km E of	37	T
Peromyscus leucopus	ASK0481	Quintana roo	Isla Cozumel, San Miguel, 1 km S of 1 km E of	37	T
Peromyscus leucopus	ASK0482	Quintana roo	Isla Cozumel, San Miguel, 1 km S of 1 km E of	37	T
Peromyscus leucopus	ASK0483	Quintana roo	Isla Cozumel, San Miguel, 1 km S of 1 km E of	37	T
Peromyscus leucopus	ASK0484	Quintana roo	Isla Cozumel, San Miguel, 1 km S of 1 km E of	37	T
Peromyscus leucopus	ASK0485	Quintana roo	Isla Cozumel, San Miguel, 1 km S of 1 km E of	37	T
Peromyscus leucopus	ASK0486	Quintana roo	Isla Cozumel, San Miguel, 1 km S of 1 km E of	37	T
Peromyscus leucopus	ASK0487	Quintana roo	Isla Cozumel, San Miguel, 1 km S of 1 km E of	37	T
Peromyscus leucopus	ASNHC1834	Quintana roo	Isla Cozumel, San Miguel, 1 km S, 1 km E	37	SK
Peromyscus leucopus	ASNHC1835	Quintana roo	Isla Cozumel, San Miguel, 1 km S, 1 km E	37	SK
Peromyscus leucopus	ASNHC1836	Quintana roo	Isla Cozumel, San Miguel, 1 km S, 1 km E	37	SK
Peromyscus leucopus	ASNHC1837	Quintana roo	Isla Cozumel, San Miguel, 1 km S, 1 km E	37	SK
Peromyscus leucopus	ASNHC1838	Quintana roo	Isla Cozumel, San Miguel, 1 km S, 1 km E	37	SK

Peromyscus leucopus	ASNHC1839	Quintana roo	Isla Cozumel, San Miguel, 1 km S, 1 km E	37	SK
Peromyscus leucopus	ASNHC1840	Quintana roo	Isla Cozumel, San Miguel, 1 km S, 1 km E	37	SK
Peromyscus leucopus	ASNHC1841	Quintana roo	Isla Cozumel, San Miguel, 1 km S, 1 km E	37	SK
Peromyscus leucopus	ASNHC1842	Quintana roo	Isla Cozumel, San Miguel, 1 km S, 1 km E	37	SK
Peromyscus leucopus	ASNHC1843	Quintana roo	Isla Cozumel, San Miguel, 1 km S, 1 km E	37	SK
Peromyscus leucopus	ASNHC1844	Quintana roo	Isla Cozumel, San Miguel, 1 km S, 1 km E	37	SK
Peromyscus leucopus	ASNHC1845	Quintana roo	Isla Cozumel, San Miguel, 1 km S, 1 km E	37	SK
Peromyscus leucopus	ASNHC1846	Quintana roo	Isla Cozumel, San Miguel, 1 km S, 1 km E	37	SK
Peromyscus leucopus	ASNHC1860	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S 1.5 km E	38	SK
Peromyscus leucopus	ASNHC1861	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S 1.5 km E	38	SK
Peromyscus leucopus	ASNHC1862	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S 1.5 km E	38	SK
Peromyscus leucopus	ASNHC1863	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S 1.5 km E	38	SK
Peromyscus leucopus	ASNHC1864	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S 1.5 km E	38	SK
Peromyscus leucopus	ASNHC1865	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S 1.5 km E	38	SK
Peromyscus leucopus	ASNHC1866	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S 1.5 km E	38	SK
Peromyscus leucopus	ASNHC1867	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S 1.5 km E	38	SK

Peromyscus leucopus	ASNHC1868	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S 1.5 km E	38	SK
Peromyscus leucopus	ASNHC1869	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S 1.5 km E	38	SK
Peromyscus leucopus	ASNHC1870	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S 1.5 km E	38	SK
Peromyscus leucopus	ASNHC1871	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S 1.5 km E	38	SK
Peromyscus leucopus	ASNHC1872	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S 1.5 km E	38	SK
Peromyscus leucopus	ASK0468	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S of 1.5 km E of	38	T
Peromyscus leucopus	ASK0469	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S of 1.5 km E of	38	T
Peromyscus leucopus	ASK0470	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S of 1.5 km E of	38	T
Peromyscus leucopus	ASK0471	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S of 1.5 km E of	38	T
Peromyscus leucopus	ASK0472	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S of 1.5 km E of	38	T
Peromyscus leucopus	ASK0473	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S of 1.5 km E of	38	T
Peromyscus leucopus	ASK0474	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S of 1.5 km E of	38	T
Peromyscus leucopus	ASK460	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S of 1.5 km E of	38	T
Peromyscus leucopus	ASK463	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S of 1.5 km E of	38	T
Peromyscus leucopus	ASK465	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S of 1.5 km E of	38	T
Peromyscus leucopus	ASK467	Quintana roo	Isla Cozumel, San Miguel, 18.5 km S of 1.5 km E of	38	T

Peromyscus leucopus	KU92422	Quintana roo	Isla Cozumel, San Miguel, 2.5 km N of	39	SK
Peromyscus leucopus	ASNHC1847	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE	40	SK
Peromyscus leucopus	ASNHC1848	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE	40	SK
Peromyscus leucopus	ASNHC1849	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE	40	SK
Peromyscus leucopus	ASNHC1850	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE	40	SK
Peromyscus leucopus	ASNHC1851	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE	40	SK
Peromyscus leucopus	ASNHC1852	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE	40	SK
Peromyscus leucopus	ASNHC1853	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE	40	SK
Peromyscus leucopus	ASNHC1854	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE	40	SK
Peromyscus leucopus	ASNHC1856	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE	40	SK
Peromyscus leucopus	ASNHC1855	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE by road	40	SK
Peromyscus leucopus	ASNHC1857	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE by road	40	SK
Peromyscus leucopus	ASNHC1858	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE by road	40	SK
Peromyscus leucopus	ASNHC1859	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE by road	40	SK
Peromyscus leucopus	ASK0544	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE of by road	40	T
Peromyscus leucopus	ASK0545	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE of by road	40	T

Peromyscus leucopus	ASK0546	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE of by road	40	T
Peromyscus leucopus	ASK0547	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE of by road	40	T
Peromyscus leucopus	ASK0548	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE of by road	40	T
Peromyscus leucopus	ASK0549	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE of by road	40	T
Peromyscus leucopus	ASK0550	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE of by road	40	T
Peromyscus leucopus	ASK0551	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE of by road	40	T
Peromyscus leucopus	ASK0552	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE of by road	40	T
Peromyscus leucopus	ASNHC7303	Quintana roo	Isla Cozumel, San Miguel, 27 km SE	41	SK
Peromyscus leucopus	ASNHC7304	Quintana roo	Isla Cozumel, San Miguel, 27 km SE	41	SK
Peromyscus leucopus	ASNHC7305	Quintana roo	Isla Cozumel, San Miguel, 27 km SE	41	SK
Peromyscus leucopus	ASNHC7306	Quintana roo	Isla Cozumel, San Miguel, 27 km SE	41	SK
Peromyscus leucopus	ASNHC7307	Quintana roo	Isla Cozumel, San Miguel, 27 km SE	41	SK
Peromyscus leucopus	ASNHC7308	Quintana roo	Isla Cozumel, San Miguel, 27 km SE	41	SK
Peromyscus leucopus	ASNHC7309	Quintana roo	Isla Cozumel, San Miguel, 27 km SE	41	SK
Peromyscus leucopus	ASNHC7310	Quintana roo	Isla Cozumel, San Miguel, 27 km SE	41	SK
Peromyscus leucopus	KU92417	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK

Peromyscus leucopus	KU92418	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Peromyscus leucopus	KU92419	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Peromyscus leucopus	KU92420	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Peromyscus leucopus	KU92421	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Peromyscus leucopus	ASNHC7311	Quintana roo	Isla Cozumel, San Miguel, 30 km SE	43	SK
Peromyscus leucopus	ASNHC7312	Quintana roo	Isla Cozumel, San Miguel, 30 km SE	43	SK
Peromyscus leucopus	ASNHC1873	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Peromyscus leucopus	ASNHC1874	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Peromyscus leucopus	ASNHC1875	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Peromyscus leucopus	ASNHC1876	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Peromyscus leucopus	ASNHC1877	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Peromyscus leucopus	ASNHC1878	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Peromyscus leucopus	ASNHC1879	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Peromyscus leucopus	ASNHC1880	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Peromyscus leucopus	ASNHC1881	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Peromyscus leucopus	ASNHC1882	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK

Peromyscus leucopus	ASNHC1883	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Peromyscus leucopus	ASNHC1884	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Peromyscus leucopus	ASNHC1885	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Peromyscus leucopus	ASNHC1886	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Peromyscus leucopus	ASNHC1887	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Peromyscus leucopus	ASNHC1888	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Peromyscus leucopus	ASNHC1889	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Peromyscus leucopus	ASNHC1890	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Peromyscus leucopus	ASNHC1891	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Peromyscus leucopus	ASNHC1892	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Peromyscus leucopus	ASK0553	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Peromyscus leucopus	ASK0492	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Peromyscus leucopus	ASK0493	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Peromyscus leucopus	ASK0494	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Peromyscus leucopus	ASK0495	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Peromyscus leucopus	ASK0496	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T

Peromyscus leucopus	ASK0497	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Peromyscus leucopus	ASK0498	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Peromyscus leucopus	ASK0499	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Peromyscus leucopus	ASK0500	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Peromyscus leucopus	ASK0501	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Peromyscus leucopus	ASNHC1832	Quintana roo	Isla Cozumel, San Miguel, 7 km N	45	SK
Peromyscus leucopus	ASNHC1833	Quintana roo	Isla Cozumel, San Miguel, 7 km N	45	SK
Peromyscus leucopus	ASNHC5847	Quintana roo	Isla Cozumel, San Miguel, 7 km N	45	SK
Peromyscus leucopus	ASNHC5848	Quintana roo	Isla Cozumel, San Miguel, 7 km N	45	SK
Peromyscus leucopus	ASNHC6316	Yucatan	Laguna Becanchen	54	SK
Peromyscus leucopus	ASNHC6317	Yucatan	Laguna Becanchen	54	SK
Peromyscus leucopus	ASNHC6318	Yucatan	Laguna Becanchen	54	SK
Peromyscus leucopus	FN30456	Yucatan	Laguna Becanchen	54	T
Peromyscus leucopus	FN30457	Yucatan	Laguna Becanchen	54	T
Peromyscus leucopus	FN30458	Yucatan	Laguna Becanchen	54	T
Peromyscus leucopus	KU92392				SK
Peromyscus leucopus	KU92393				SK
Peromyscus leucopus	KU92394				SK
Reithrodontomys gracilis	ASNHC6356	Campeche	Champoton, 52 km SW	7	SK
Reithrodontomys gracilis	ASNHC6357	Campeche	Champoton, 52 km SW	7	SK
Reithrodontomys gracilis	ASNHC6358	Campeche	Champoton, 52 km SW	7	SK
Reithrodontomys gracilis	ASNHC6359	Campeche	Champoton, 52 km SW	7	SK

Reithrodontomys gracilis	ASNHC6360	Campeche	Champoton, 52 km SW	7	SK
Reithrodontomys gracilis	ASNHC6361	Campeche	Champoton, 52 km SW	7	SK
Reithrodontomys gracilis	ASNHC6362	Campeche	Champoton, 52 km SW	7	SK
Reithrodontomys gracilis	ASNHC6363	Campeche	Champoton, 52 km SW	7	SK
Reithrodontomys gracilis	ASNHC6364	Campeche	Champoton, 52 km SW	7	SK
Reithrodontomys gracilis	ASNHC6365	Campeche	Champoton, 52 km SW	7	SK
Reithrodontomys gracilis	ASNHC6366	Campeche	Champoton, 52 km SW	7	SK
Reithrodontomys gracilis	ASNHC6367	Campeche	Champoton, 52 km SW	7	SK
Reithrodontomys gracilis	ASNHC7433	Campeche	Champoton, 52 km SW	7	SK
Reithrodontomys gracilis	FN29681	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN29682	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN29684	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN29685	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN29687	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN29688	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN29689	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN29690	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN29714	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN29715	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN29716	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN29717	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN29718	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN29683	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN29686	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN30681	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN30682	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN30683	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN30684	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN30685	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN30686	Campeche	Champoton, 52 km SW of	7	T

Reithrodontomys gracilis	FN30687	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN30688	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN30689	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN30696	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN30697	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN30698	Campeche	Champoton, 52 km SW of	7	T
Reithrodontomys gracilis	FN30133	Campeche	CheKUbul, 3.7 km SE of	8	T
Reithrodontomys gracilis	FN30227	Campeche	CheKUbul, 3.7 km SE of	8	T
Reithrodontomys gracilis	FN30228	Campeche	CheKUbul, 3.7 km SE of	8	T
Reithrodontomys gracilis	FN29204	Campeche	Constitucion (27.5 km S of), Escarcega (27.5 km S, 70 km E of)	9	T
Reithrodontomys gracilis	ASNHC7434	Campeche	Constitucion (9.5 km S of), Escarcega (9.5 km S 70 km E)	10	SK
Reithrodontomys gracilis	ASK2620	Campeche	Constitucion (9.5 km S of), Escarcega (9.5 km S 70 km E)	10	T
Reithrodontomys gracilis	ASK2622	Campeche	Constitucion (9.5 km S of), Escarcega (9.5 km S 70 km E)	10	T
Reithrodontomys gracilis	KU95085	Campeche	Dzibalchen	11	SK
Reithrodontomys gracilis	KU96820	Campeche	Dzibalchen	11	SK
Reithrodontomys gracilis	KU96821	Campeche	Dzibalchen	11	SK
Reithrodontomys gracilis	KU96822	Campeche	Dzibalchen	11	SK
Reithrodontomys gracilis	KU96823	Campeche	Dzibalchen	11	SK
Reithrodontomys gracilis	ASNHC6368	Campeche	Dzibalchen, 60 km SE	12	SK
Reithrodontomys gracilis	FN30671	Campeche	Dzibalchen, 60 km SE of	12	T
Reithrodontomys gracilis	KU93705	Campeche	Escarcega, 128 km E of	15	SK
Reithrodontomys gracilis	KU93704	Campeche	Escarcega, 7 km N, 51 km E of	18	SK
Reithrodontomys gracilis	ASNHC2128	Campeche	Escarcega, 7.5 km W	19	SK
Reithrodontomys gracilis	ASNHC2129	Campeche	Escarcega, 7.5 km W	19	SK
Reithrodontomys gracilis	ASK0308	Campeche	Escarcega, 7.5 km W of	19	T
Reithrodontomys gracilis	ASNHC2130	Campeche	Hopelchen, 43 km N by road	20	SK

Reithrodontomys gracilis	KU96826	Campeche	Isla del Carmen, Ciudad del Carmen, 16 mi NE of	21	SK
Reithrodontomys gracilis	KU96828	Campeche	Isla del Carmen, Ciudad del Carmen, 16 mi NE of	21	SK
Reithrodontomys gracilis	KU96829	Campeche	Isla del Carmen, Ciudad del Carmen, 16 mi NE of	21	SK
Reithrodontomys gracilis	KU96830	Campeche	Isla del Carmen, Ciudad del Carmen, 16 mi NE of	21	SK
Reithrodontomys gracilis	KU96831	Campeche	Isla del Carmen, Ciudad del Carmen, 16 mi NE of	21	SK
Reithrodontomys gracilis	KU96832	Campeche	Isla del Carmen, Ciudad del Carmen, 16 mi NE of	21	SK
Reithrodontomys gracilis	KU96833	Campeche	Isla del Carmen, Ciudad del Carmen, 16 mi NE of	21	SK
Reithrodontomys gracilis	KU96834	Campeche	Isla del Carmen, Ciudad del Carmen, 16 mi NE of	21	SK
Reithrodontomys gracilis	KU96835	Campeche	Isla del Carmen, Ciudad del Carmen, 16 mi NE of	21	SK
Reithrodontomys gracilis	KU96836	Campeche	Isla del Carmen, Ciudad del Carmen, 16 mi NE of	21	SK
Reithrodontomys gracilis	KU96837	Campeche	Isla del Carmen, Ciudad del Carmen, 16 mi NE of	21	SK
Reithrodontomys gracilis	KU96838	Campeche	Isla del Carmen, Ciudad del Carmen, 16 mi NE of	21	SK
Reithrodontomys gracilis	KU96839	Campeche	Isla del Carmen, Ciudad del Carmen, 16 mi NE of	21	SK
Reithrodontomys gracilis	KU96840	Campeche	Isla del Carmen, Ciudad del Carmen, 16 mi NE of	21	SK
Reithrodontomys gracilis	KU96841	Campeche	Isla del Carmen, Ciudad del Carmen, 16 mi NE of	21	SK
Reithrodontomys gracilis	KU96842	Campeche	Isla del Carmen, Ciudad del Carmen, 16 mi NE of	21	SK
Reithrodontomys gracilis	KU96843	Campeche	Isla del Carmen, Ciudad del Carmen, 16 mi NE of	21	SK
Reithrodontomys gracilis	KU96844	Campeche	Isla del Carmen, Ciudad del Carmen, 16 mi NE of	21	SK
Reithrodontomys gracilis	KU96845	Campeche	Isla del Carmen, Ciudad del Carmen, 16 mi NE of	21	SK
Reithrodontomys gracilis	KU96847	Campeche	Isla del Carmen, Ciudad del Carmen, 16 mi NE of	21	SK
Reithrodontomys gracilis	KU96848	Campeche	Isla del Carmen, Ciudad del Carmen, 16 mi NE of	21	SK
Reithrodontomys gracilis	ASNHC2127	Campeche	Isla del Carmen, Ciudad del Carmen, 21.2 km E	22	SK
Reithrodontomys gracilis	ASNHC5945	Campeche	Isla del Carmen, Ciudad del Carmen, 21.2 km E	22	SK
Reithrodontomys gracilis	ASK0382	Campeche	Isla del Carmen, Ciudad del Carmen, 21.2 km E of	22	T
Reithrodontomys gracilis	ASK0383	Campeche	Isla del Carmen, Ciudad del Carmen, 21.2 km E of	22	T
Reithrodontomys gracilis	KU92261	Campeche	Isla del Carmen, Ciudad del Carmen, 3 mi E of	23	SK
Reithrodontomys gracilis	FN29612	Campeche	Isla del Carmen, Ciudad del Carmen, 47 km NE of	24	T
Reithrodontomys gracilis	FN29613	Campeche	Isla del Carmen, Ciudad del Carmen, 47 km NE of	24	T
Reithrodontomys gracilis	FN29713	Campeche	Isla del Carmen, Ciudad del Carmen, 47 km NE of	24	T
Reithrodontomys gracilis	KU92264	Campeche	Isla del Carmen, puerto real, 1 km SW of	25	SK

Reithrodontomys gracilis	KU92266	Campeche	Isla del Carmen, puerto real, 1 km SW of	25	SK
Reithrodontomys gracilis	FN29004	Campeche	La Valeta	26	T
Reithrodontomys gracilis	KU65384	Peten	Uaxactun	29	SK
Reithrodontomys gracilis	KU65385	Peten	Uaxactun	29	SK
Reithrodontomys gracilis	KU93703	Quintana roo	Chetumal, 27 km NW of	30	SK
Reithrodontomys gracilis	KU92258	Quintana roo	Felipe Carrillo Puerto, 4 km NNE of	32	SK
Reithrodontomys gracilis	KU92256	Quintana roo	Pueblo Nuevo X-can	48	SK
Reithrodontomys gracilis	ASNHC7435	Tabasco	El Triunfo, 27 km S 14 km E	52	SK
Reithrodontomys gracilis	FN29815	Yucatan	Cenote Seco, Chichen Itza, 2 km E of	53	T
Reithrodontomys gracilis	ASNHC6369	Yucatan	Laguna Becanchen	54	SK
Reithrodontomys gracilis	ASNHC6371	Yucatan	Laguna Becanchen	54	SK
Reithrodontomys gracilis	ASNHC6372	Yucatan	Laguna Becanchen	54	SK
Reithrodontomys gracilis	FN30425	Yucatan	Laguna Becanchen	54	T
Reithrodontomys gracilis	FN30426	Yucatan	Laguna Becanchen	54	T
Reithrodontomys gracilis	FN30459	Yucatan	Laguna Becanchen	54	T
Reithrodontomys gracilis	FN30460	Yucatan	Laguna Becanchen	54	T
Reithrodontomys gracilis	FN32809	Yucatan	Uman	58	T
Reithrodontomys gracilis	FN32810	Yucatan	Uman	58	T
Reithrodontomys gracilis	ASNHC7436	Yucatan	Uman, 8 km SW	59	SK
Reithrodontomys gracilis	ASK3533	Yucatan	Yucatan	60	T
Reithrodontomys gracilis	KU92253				SK
Reithrodontomys gracilis	KU92254				SK
Reithrodontomys gracilis	KU92255				SK
Reithrodontomys gracilis	KU93702				SK
Reithrodontomys spectabilis	ASK3532	Quintana roo	Isla Cozumel	33	T
Reithrodontomys spectabilis	FN32948	Quintana roo	Isla Cozumel, El Cedral	34	T

Reithrodontomys spectabilis	FN32949	Quintana roo	Isla Cozumel, El Cedral	34	T
Reithrodontomys spectabilis	FN32950	Quintana roo	Isla Cozumel, El Cedral	34	T
Reithrodontomys spectabilis	FN32951	Quintana roo	Isla Cozumel, El Cedral	34	T
Reithrodontomys spectabilis	FN32952	Quintana roo	Isla Cozumel, El Cedral	34	T
Reithrodontomys spectabilis	FN32953	Quintana roo	Isla Cozumel, El Cedral	34	T
Reithrodontomys spectabilis	ASNHC7438	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK
Reithrodontomys spectabilis	ASNHC7442	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK
Reithrodontomys spectabilis	ASNHC7443	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N	35	SK
Reithrodontomys spectabilis	FN33213	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N of	35	T
Reithrodontomys spectabilis	FN33214	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N of	35	T
Reithrodontomys spectabilis	FN33215	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N of	35	T
Reithrodontomys spectabilis	FN33216	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N of	35	T
Reithrodontomys spectabilis	FN33223	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N of	35	T
Reithrodontomys spectabilis	FN33224	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N of	35	T
Reithrodontomys spectabilis	FN33225	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N of	35	T
Reithrodontomys spectabilis	FN33226	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N of	35	T

Reithrodontomys spectabilis	FN33227	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N of	35	T
Reithrodontomys spectabilis	FN33228	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N of	35	T
Reithrodontomys spectabilis	FN33229	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N of	35	T
Reithrodontomys spectabilis	FN33230	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N of	35	T
Reithrodontomys spectabilis	FN33231	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N of	35	T
Reithrodontomys spectabilis	FN33232	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N of	35	T
Reithrodontomys spectabilis	FN33233	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N of	35	T
Reithrodontomys spectabilis	FN33234	Quintana roo	Isla Cozumel, El Cedral, 1.5 km N of	35	T
Reithrodontomys spectabilis	FN32988	Quintana roo	Isla Cozumel, San Miguel	36	T
Reithrodontomys spectabilis	FN32989	Quintana roo	Isla Cozumel, San Miguel	36	T
Reithrodontomys spectabilis	KU92295	Quintana roo	Isla Cozumel, San Miguel, 2.5 km N of	39	SK
Reithrodontomys spectabilis	ASNHC2137	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE by road	40	SK
Reithrodontomys spectabilis	ASK0543	Quintana roo	Isla Cozumel, San Miguel, 20.3 km SE of by road	40	T
Reithrodontomys spectabilis	ASNHC7444	Quintana roo	Isla Cozumel, San Miguel, 27 km SE	41	SK
Reithrodontomys spectabilis	ASNHC7445	Quintana roo	Isla Cozumel, San Miguel, 27 km SE	41	SK
Reithrodontomys spectabilis	KU92281	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK

Reithrodontomys spectabilis	KU92282	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Reithrodontomys spectabilis	KU92283	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Reithrodontomys spectabilis	KU92285	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Reithrodontomys spectabilis	KU92286	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Reithrodontomys spectabilis	KU92287	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Reithrodontomys spectabilis	KU92288	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Reithrodontomys spectabilis	KU92289	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Reithrodontomys spectabilis	KU92290	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Reithrodontomys spectabilis	KU92291	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Reithrodontomys spectabilis	KU92292	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Reithrodontomys spectabilis	KU92293	Quintana roo	Isla Cozumel, San Miguel, 3.5 km N of	42	SK
Reithrodontomys spectabilis	ASNHC2138	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Reithrodontomys spectabilis	ASNHC2139	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Reithrodontomys spectabilis	ASNHC2140	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Reithrodontomys spectabilis	ASNHC2141	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Reithrodontomys spectabilis	ASNHC2142	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK

Reithrodontomys spectabilis	ASNHC2143	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Reithrodontomys spectabilis	ASNHC2144	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Reithrodontomys spectabilis	ASNHC2145	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Reithrodontomys spectabilis	ASNHC2146	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Reithrodontomys spectabilis	ASNHC2147	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Reithrodontomys spectabilis	ASNHC2148	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Reithrodontomys spectabilis	ASNHC2149	Quintana roo	Isla Cozumel, San Miguel, 30 km SE by road	43	SK
Reithrodontomys spectabilis	ASK0587	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Reithrodontomys spectabilis	ASK0527	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Reithrodontomys spectabilis	ASK0528	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Reithrodontomys spectabilis	ASK0530	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Reithrodontomys spectabilis	ASK0531	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Reithrodontomys spectabilis	ASK0555	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Reithrodontomys spectabilis	ASK0574	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Reithrodontomys spectabilis	ASK0575	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Reithrodontomys spectabilis	ASK0576	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T

Reithrodontomys spectabilis	ASK0577	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Reithrodontomys spectabilis	ASK0524	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Reithrodontomys spectabilis	ASK0525	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Reithrodontomys spectabilis	ASK0526	Quintana roo	Isla Cozumel, San Miguel, 30 km SE of by road	43	T
Reithrodontomys spectabilis	ASK0542	Quintana roo	Isla Cozumel, San Miguel, 7 km N of	45	T