Evaluation of Animal Control Measures on Pet Demographics in Santa Clara County, California, 1993- 2006

A prospective cross-sectional study of 1000 households was implemented in 2005 to evaluate characteristics of the owned and unowned population of dogs and cats in Santa Clara County, California. The same population was previously studied 12 years earlier. During this time period, the county instituted in 1994 and then subsequently disestablished a municipal spay/neuter voucher program for cats. Dog intakes declined from 1992-2005, as they similarly did for an adjacent county (San Mateo). However, cat intakes declined significantly more in Santa Clara County than San Mateo, with an average annual decline of approximately 700 cats for the 12 year period. Time series analysis showed a greater than expected decline in the number of cats surrendered to shelters in Santa Clara County during the years the voucher program was in effect (1994-2005). The net savings to the county by reducing the number of cat shelter intakes was estimated at approximately $1.5 million.

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15   Abstract

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17   A prospective cross-sectional study of 1000 households was implemented in 2005 to evaluate

18   characteristics of the owned and unowned population of dogs and cats in Santa Clara County,

19   California. The same population was previously studied 12 years earlier. During this time

20   period, the county instituted in 1994 and then subsequently disestablished a municipal

21   spay/neuter voucher program for cats. Dog and cat intakes declined from 1992-2005, as they

22   similarly did for an adjacent county (San Mateo). Time series analysis showed a greater than

23   expected decline in the number of cats surrendered to shelters in Santa Clara County during the

24   years the voucher program was in effect (1994-2005). The net savings to the county by reducing

25   the number of cat shelter intakes was estimated at approximately $1.5 million.

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27   *Keywords*: animal euthanasia, animal population groups, epidemiology, population control,

28   population policy

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33   One of the greatest threats to the lives of cats and dogs in contemporary American society

34   does not come from infectious or noninfectious disease, but rather from the threat of being

35   unowned or becoming unwanted and susceptible to abandonment or relinquishment to shelters.

36   Each year millions of healthy and potentially adoptable pets are euthanized for lack of ownership

37   or residence; the most palpable manifestation of this is witnessed at local municipal or private

38   animal shelters (Salman et al. 1998). The financial burden of managing this overabundance of

39   pets to communities across the United States is enormous and incalculable (Zanowski 2010).

40   Scientific investigations into pet population dynamics have evolved from the purely

41   descriptive to the analytic, particularly with respect to studying determinants of relinquishment.

42   Many studies performed in the United States have sought to quantify characteristics of animals

43   as well as their owners that appear to be proscriptive for an impairment of the human-animal

44   bond . The cumulative effect of these studies has led to a better understanding of why

45   relinquishment occurs, but the enduring challenge remains how to use such information to

46   implement prevention and/or intervention strategies. A prototypical example of these strategies

47   is the establishment of community spay and neuter programs. Such programs can be sponsored

48   either by municipalities or humane organizations, both of which often jointly serve critical

49   animal control needs in communities and frequently join together in collaboration to achieve

50   their mutual goals.

51   Santa Clara County, California is an opportune place to study the results of intervention

52   strategies. As of 2005 the 1,291 square mile county contained 1.76 million people (in an

53   estimated 603,000 households, averaging 2.92 persons per household), with more than half

54   (945,000) living in San Jose, and over 200,000 more living in the cities of Sunnyvale and Santa

55   Clara . The ethnic distribution was approximately 44% Caucasian, 25% Asian/Pacific Islander,

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56 24% Hispanic/Latino, 3% African-American, and 4% other groups . Per capita annual growth

57 has been approximately 1.2%; annual household growth has increased approximately 0.8% over

58 the past 15 years .

59   Two major animal shelters operate: the City of San Jose Animal Care & Services

60 (SJACS) which opened in 2004, and the Humane Society of Silicon Valley (HSSV) facility in

61 Santa Clara, which accepted up to 25,000 animals per year. The latter predominantly provided

62 sheltering services until late 1992, when for financial reasons the County ceased field services

63 for cats, only accepting those owner-reliquished. The HSSV recommenced services 14 months

64 later for most of the County.

65   The number of cats entering the HSSV climbed approximately 25% (from 20,000 to

66 25,000 cats) from 1983 to 1990, and remained close to its high until Santa Clara County field

67 services ended in 1992; in 1993 the total number of incoming live cats returned to 20,000 .

68 Approximately 60% of incoming animals to HSSV arrived through field services. Upon

69 resumption of these services in 1994, San Jose instituted a free spay/neuter voucher program to

70 reduce its number of stray cats, and initiated one for dogs in 1995. These programs ceased in

71 2003 in anticipation of the SJACS opening, but temporarily resumed in 2005 until the latter

72 opened its own low-cost spay/neuter clinic in 2006. Santa Clara County also instituted a

73 low-cost spay/neuter program in 1998 with almost $50,000 in annual funding.

74   A local non-profit organization of cat and dog owners and fanciers[a] commissioned a

75 survey of Santa Clara County residents in 1993 . The purpose of this survey was estimate the

76 number of owned and unowned cats and dogs in the county. Investigators interviewed people by

77 telephone from 1,031 households throughout all parts of the County except the city of Palo Alto

78 (whose small shelter declined to provide intake statistics), and determined that 51% of

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79   households did not own pets, 19% owned only cats, 19% owned only dogs, and 11 % owned

80   both cats and dogs. Households that owned cats and dogs had an average of 1.7 cats and of 1.3

81   dogs, respectively. Ten percent of all households (48% of which did not own pets) also cared for

82   an average of 3.4 stray cats. Strays, sometimes referred to as community cats, are free-roaming,

83   unowned, or feral; the latter do not allow human touch. These figures led investigators to

84   estimate that in 1993 the number of owned cats and dogs in the county was approximately

85   247,000 and 195,000, respectively (Cat Fanciers Almanac 1994). Of particular importance was

86   the projection that the County had approximately 169,000 unowned but fed cats (41% of all cats

87   in the county), a figure that does not account for unowned but unfed and feral cats.

88   The purpose of the current study, conducted in 2005, was to revisit the population of cats

89   and dogs in Santa Clara County 12 years following the earlier study, and to correlate pet

90   population changes with the institution or disestablishment of animal population control

91   programs, including vouchers, field services, and low-cost spay and neuter facilities. The

92   hypothesis was that these programs would be associated with a reduction in the pet populations

93   in Santa Clara County that differed from that of an adjacent comparison county, with resultant

94   cost savings to the county.

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96   **Materials and Methods**

97   *Study population*

98   The same private survey firm used in 1993 was commissioned to conduct a similar

99   random telephone survey of 1,000 households throughout Santa Clara County except Palo Alto

100   (which has its own small shelter and did not participate in 1993). An equal probability of

101   selection method (EPSEM) phone list of residential landline telephone numbers for the survey

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102 was purchased from a private company.[1] Three attempts were made at each number over

103 successive nights. Over 7,000 calls (including disconnected lines, no answers, refusals) were

104 attempted to reach 1000 respondents. People who agreed to be questioned were asked whether

105 or not they owned dogs or cats, fed stray dogs or cats, whether or not the animals had been

106 altered, if they had reproduced, if cats had been declawed, how they obtained their pets, whether

107 or not cats were allowed outside, purebred status, city of residence, and residence type. Data was

108 initially recorded on written interview forms, and manually entered into a Microsoft Excel 2007

109 (Microsoft Corporation, Redmond, WA) spreadsheet for statistical analysis.

110   Animal shelter entry information was provided by Santa Clara County Animal Control,

111 Humane Society of Silicon Valley, San Jose Animal Care and Services, and for comparative

112 purposes the Peninsula Humane Society and SPCA in neighboring San Mateo County and Los

113 Angeles County Animal Control. Spay/neuter voucher program information, costs and statistics

114 were obtained from the City of San Jose, and County of Santa Clara. San Mateo County was

115 chosen for comparative purposes, as it most closely resembled Santa Clara County, as opposed to

116 the other four more rural surrounding counties.

117

118 *Statistical analysis*

119   The 1982-1993 Santa Clara County shelter intake records (from before the launch of the

120 spay/neuter voucher program) were used for projecting the expected numbers of shelter intakes

121 from 1994 to 2005. US Census data was used to determine the number of county households,

122 which was used with survey-derived estimates of the average number of dogs and cats per

123 household and proportion of households that owned dogs and cats to estimate the number of

124 owned dogs and cats in the county, and with survey-derived estimates of the percentage of

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125 households feeding stray dogs and the average number of unowned but fed dogs and cats per

126 household to estimate the number of stray dogs and cats in the county.

127 Data from the survey was initially described using proportions. Pearson's chi-square test

128 was used to compare proportions; p-values < 0.05 were considered statistically significant. The

129 observed numbers of shelter intakes between 1994 and 2005, during which the spay/neuter

130 program was in place, were compared with projected numbers based on varying the proportion

131 of cats in the voucher program that were owned versus unowned to assess the program's effect

132 (i.e., change in numbers of shelter intakes). Autoregressive integrated moving average (ARIMA

133 (p, q, d, where p = order of autoregression, q = order of moving averages, and d = order of

134 differencing)) models were fit to the data before the launch of the spay/neuter voucher program

135 (1982 to 1993). Autocorrelation function (ACF) and partial autocorrelation function (PACF)

136 plots were used to select the best-fit ARIMA models and to evaluate the model fit. The selected

137 ARIMA models were then used to estimate and project the trend in number of shelter intakes

138 after the implementation of spay/neuter program (1994 to 2005) with corresponding 95%

139 confidence limits of the ARIMA projections. In addition, we constructed a stochastic model to

140 estimate the number of additional cats that would have been born and taken into the shelters

141 between 1994 and 2005 had the spay/neuter program never been implemented. The key

142 parameters, their corresponding probability distributions for owned and unowned cats, and the

143 data sources are listed in Table 1. This model was also used for benefit-cost analysis of the

144 voucher program. The software program @Risk (version 5.0.0, Palisade Corp., Ithaca, New

145 York) was used for the simulation, using Latin Hypercube sampling and Mersenne Twister

146 generator with a fixed initial seed of 12345 for 10,000 iterations. Median and the 5th and 95th

147 percentiles were reported.

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Results

Dog survey results

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151   Twenty nine percent of responding county households reported that they owned dogs

152 (unchanged from 1993); the average household owned 1.9 dogs, representing an increase from

153 1.3 dogs in 1993. Using US census data led to an estimate of 332,000 owned dogs in Santa Clara

154 County (assuming Palo Alto has the same ownership frequency). Registered and unregistered

155 purebred dogs were 33% and 18% (total = 51%) of the dog population, respectively; the

156 remainder (49%) of dogs was either mixed or unknown breeds. Dogs were acquired from a

157 variety of sources; the most common were friends or relatives (30%), breeders (25%), public or

158 private animal shelter (15%), with the remainder (less than 10% each) coming from a breed

159 rescue group, a newspaper advertisement, found as stray, being born at home, acquired from a

160 pet store, and rare other sources (Fig.1).

161   Seventy five percent (75%) of owners reported surgically sterilizing their dogs. Among

162 those that declined to alter them, 28% of owners said this was a deliberate decision, and none

163 claimed that cost was a justification for not sterilizing. Thirty three percent (33%) of the

164 unaltered dogs were intended for breeding purposes, and 17% were puppies too young for

165 surgery. Of the 99 unaltered dogs, 70 (70.7%) were male and 29 (29.3%) were female.

166   Twenty one households (2%) in the survey acknowledged feeding dogs they did not own,

167 with an average of 2.3 dogs per feeding household. An examination of zip codes indicated that

168 the majority of these dogs were found in the downtown and north and east sides of the city of

169 San Jose. With some exceptions, these areas are in the lower socio-economic range of

170 households in San Jose. Using US census data, this leads to an estimate of approximately 15,650

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171 transiently or permanently stray dogs throughout the county, or 4.7% of the county's dog

172 population.

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174 *Cat survey results*

175   Twenty five percent of households reported owning cats, representing a decrease from

176 30% in 1993 ($p = 0.013$). With an average of 1.7 owned cats per household (a figure unchanged

177 since 1993), the county's owned cat population was estimated at 256,000 cats. Most cats (85%)

178 were characterized as domestic varieties; only 3% were claimed to be registered pedigree (a

179 figure unchanged since 1993), while others were described as unregistered pedigreed or

180 unknown breed. The percentage of cats kept strictly indoors rose from 33% in 1993 to 49% in

181 2005 ($p < 0.001$); only 8% were currently described as strictly outdoors, down from 14% in 1993

182 ($p < 0.001$).

183   The most common source of owned cats was from a friend or relative (42% in 2005

184 versus 33% in 1993), followed by being found as a free-roaming homeless cat (20% in 2005

185 versus 32% in 1993), a public or private animal shelter (16% in 2005 versus 12% in 1993), a

186 breed rescue group (9% in 2005 versus 2% in 1993), a breeder (4% in both years), an ad in a

187 newspaper or adopted or purchased in a pet store (2% in 2005 versus 6% in 1993), a negligible

188 percentage born at home (<1% in 2005 versus 6% in 1993), and the remainder coming from

189 various minor or unknown sources. The *p*-value comparing the source distribution of owned cats

190 between 2005 and 1993 was < 0.001.

191   In 2005 most cat owners (92.8%) had their cats surgically sterilized, compared to 86% in

192 1993 ($p < 0.001$). Within the 7.2% of cats not spayed or neutered, 48% had owners that

193 deliberately did not want their cats to be sterilized, 13% had owners who wanted to retain the cat

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194 for breeding, 13% were kittens, 13% had owners claiming that the costs were prohibitive, and the

195 remainder gave two or more reasons (the most common of which was lack of time to transport

196 the cat for surgery). Thus, only approximately 6% of owned cats were sexually mature and

197 capable of breeding, approximately half of which were female. However, less than one-half of

198 1% of owners of sterilized female cats allowed their cats to have a litter prior to sterilization.

199 The rate of reproduction of owned cats in Santa Clara County was 89 cats per 1000

200 households, in contrast to the higher rate of 112 kittens per 1000 households in the 1996 National

201 Council on Pet Population Study and Policy (Salman et al., 1998). This may be attributable to

202 the high proportion of altered cats in the county (93%) relative to the comparable 1993 figure

203 and the 2005 national average of 86%. In addition, while in 1993 16% of owned cats had a litter

204 prior to altering, in the current study this figure was less than one-half of 1%. While it was

205 beyond the scope of this study to determine the reasons for this change in attitude, it is likely that

206 greater awareness prompted by considerable multimedia public education about the

207 county-sponsored voucher program instituted in 1993 bore at least some responsibility.

208 When owners were asked about whether their cats were declawed, 8% stated that they

209 were, but 29% of them obtained the cat in that condition. The most common reason given by

210 owners (84%) for declawing was to protect furniture. Owners not electing to declaw their cats

211 protected their furniture through a variety of means, including having scratching posts and mats,

212 using a spray bottle, clipping the claws, applying double-sided tape, and making loud deterrent

213 noises.

214 Many individuals fed stray cats: 7% of household respondents admitted to feeding an

215 average of 3.2 cats, a decrease from 10% with an average of 3.4 cats in 1993. Relying on U.S.

216 census data, the estimated fed stray cat population is therefore approximately 135,000 cats, or

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217   approximately 35% of the total owned and fed free-roaming/unowned cat population in the

218   county (391,000 cats, which represents a drop from 416,000 in 1993). Only 5.5% of these cats

219   were either trapped or taken to be surgically sterilized by their people feeding them. Fifty six

220   percent of the cats were fed daily, while the remaining cats were fed from once every other day

221   to only occasionally. The cats were most commonly fed on the doorstep of a person's home

222   (62%), followed by an office (15%), a park (12%), and a shopping center (<1%). Fed stray cats

223   were either alone or belonged to colonies ranging in size from 2 to 25 cats. Two-thirds of the fed

224   stray cats were too wild to be picked up and were defined as feral; the remaining third were

225   classified as unowned (although some of these may have had owners unknown to the survey

226   respondent).   Forty seven percent of the female stray cats were known to have had at least one

227   litter, which is probably a conservative estimate. Over half of the known litters were allowed to

228   remain free and disperse into their neighborhoods. Of the remaining kittens, half were kept by

229   the feeder, while the others were given away or taken to an animal shelter. Of the females who

230   had litters, 58% were not trapped or taken to a veterinarian after having a litter, remaining free to

231   potentially breed again.

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233   *Population changes at Santa Clara County Animal Shelters*

234   Changes in dog shelter intakes for Santa Clara County (and the Peninsula Humane

235   Society and SPCA shelter in adjacent San Mateo County for comparison) are shown in Fig. 2.

236   Dog intakes declined 13,643 to 8,441 (38.1%) from 1992-2005 in Santa Clara County. An

237   external explanation for the observed trend is supported by the findings in adjacent San Mateo

238   County, where dog intakes declined by a similar 35.7% between 1990 and 2004. These

239   proportions were not significantly different ($p = 0.11$).

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240   A substantially different picture emerged when examining changes in cat shelter intakes

241   in Santa Clara and San Mateo Counties (Figs. 3 and 4). Intakes in Santa Clara County dropped

242   22,473 to 16,369 (27.2%) from 1993 to 2004 and 22,473 to 16,807 (25.2%) from 1993 to 2005,

243   compared to a drop of 8,252 to 6,078 (26.3%) in San Mateo County from 1993 to 2004.

244   Although the two 1993 to 2004 proportions were similar ($p = 0.16$), there was an overall decline

245   in annual intakes in Santa Clara County of 6,104 cats to 2004 (509 cats per year) for the 12 year

246   period, compared to 2,174 cats in the same 12 year period for San Mateo County (181 cats per

247   year). The absolute changes are economically more germane to counties with respect to shelter

248   expenses because expenditures are based on the per diem cost of maintaining individual cats.

249   The results of the ARIMA (1,0,1) projections indicated a higher-than-expected cat intake to

250   shelters in Santa Clara County during the years when the voucher program was in effect, i.e.,

251   1994-2005 (Fig.5). The ARIMA (1,0,1) projections further showed that the observed numbers of

252   cats brought in by the field service did not substantially differ from the expected numbers during

253   the same time period (Fig.6).

254   Information provided by the HSSV shelter indicated that the majority of cats entering the

255   shelter were unweaned kittens and feral cats. From 2000 to 2004, the HSSV euthanized 53,419

256   cats deemed unadoptable: 14,406 were too young (under four weeks of age), 7,912 were

257   unsociable, and 7,595 were feral.

258   Under the voucher program, 20,419 cats were surgically sterilized from 1994-2001 and

259   an additional 6,231 cats were sterilized from 2001-2003. While the program was initiated at the

260   end of 1994, public interest did not start until mid-1995, when a local television station and

261   newspaper ran a story about it.

262   The San Jose program was initially free to the public; however, various program changes

263   over time were instituted. Veterinarians were reimbursed at a set fee of $25 female and $15

264   male. Pregnancies could add to the veterinarian reimbursement up to $50, and anatomical issues

265   adjusted the price to as high as $150. In 1996 modifications included requiring a $5 co-pay, and

266   a requirement that cat owners obtain a $5 license and rabies inoculation. While these changes

267   increased the veterinarian reimbursement, they also created a negative effect on the program, as

268   voucher requests declined from 5,600 in the first 16 months of the program to only 2,800 for the

269   year following the changes.

270   The San Jose voucher program ended in 2003, but the county program continued.

271   Utilizing assumptions in Table 1, if no voucher program had been initiated, the same cats

272   enrolled in the voucher program (assuming that 65% were owned, based on the 2005 survey

273   results) would have produced approximately 312,000 kittens between 1994 and 2005, and

274   approximately 8,600 additional cats would have entered (6,200 surrendered and 2,500 brought in

275   by the field service) the shelters in Santa Clara County. This would have incurred an additional

276   cost of approximately $2.15 million, with the HSSV charge to cities for stray cat services under

277   their contract cost of $250 per cat. If the cost per cat for spay/neuter surgery in 2001-2002

278   ($23.21 average for all surgeries) can be assumed to be constant from 1994-2005, then the

279   expected cost of the HSSV voucher program was approximately $620,000. Thus, the net gain of

280   the program from reducing the number of cat shelter intakes was approximately $1.53 million.

281   Not counted would be the added burden of approximately 44,000 cats to the stray population in

282   the county.

283   The proportion of feral cats actually altered in the program considerably fluctuated: from

284   77% in 2006 to 82% in 2007 to 48% in 2008 (the latter data is from San Jose only). Table 2

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285 contains projections of how county cat and shelter populations would be expected to change in

286 the absence of the voucher program under different owned versus feral cat ratios. Under all

287 plausible scenarios, ranging from 20% to 80% of the altered cats being feral, the costs to the

288 shelters would have likely exceeded $2 million over the 12-year life of the program, and at the

289 higher proportion of feral cats the costs would have likely exceeded $6 million.

290

291 **Discussion**

292 This study documents the positive impacts publically subsidized low-cost spay and neuter

293 programs can have that often go unmet in communities: pet population control, leading to the

294 prevention of the proliferation of feral dog and cat populations, slowing the flow of animals into

295 shelters both voluntarily and through field services, and reduction in the incidence of humane

296 destruction of animals. But they also extend to other issues of economic importance to

297 communities; namely, reduction in capital and ongoing animal control expenditures that come

298 under a municipality's jurisdiction. In contrast, the implication of cessation of such programs

299 can be seen in Figures 2 and 3 when the decline in shelter admissions of dogs and cats became

300 attenuated. The problem could be exacerbated over time as the human (and hence pet-owning)

301 population increases.

302 The finding that there were over 15,000 dogs (4.7% of the county's dog population)

303 estimated to be transiently or permanently stray throughout the county is troubling from societal

304 and public health standpoints. The absence of a domestic environment can lead stray dogs,

305 which are by nature gregarious, to form packs that can become aggressive and endanger other

306 animals and even humans. The origin of such a large number of dogs is worthy of further

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307 research, as this study did not explore whether these were free-roaming dogs or those kept in

308 temporary foster or rescue care.

309   Specific breed information was not available for dogs in Santa Clara County animal

310 shelters. Respondents claimed 51% of their dogs were registered and unregistered purebred dogs.

311 This stands in contrast to a 1996 national survey that found 30% of dogs relinquished to shelters

312 were purebred (Salman et al. 1998), and the Humane Society of the United States estimates that

313 25-30% of shelter dogs are purebred (The Humane Society of the United States 2011).

314 Nationally, purebred dogs are substantially less likely to be relinquished to animal shelters than

315 dogs of mixed breed (Salman et al. 1998).

316   The dogs with greatest likelihood of successful adoption from county animal shelters are

317 puppies (Lepper, Kass & Hart 2002). By the time dogs reach the age of one year, though, their

318 risk of unsuccessful adoption following relinquishment rises considerably; again, particularly

319 true in pit bull-like breeds (Lepper, Kass & Hart 2002). Aggressive dog behavior is a major

320 reason dogs are euthanized at the county shelters (Kass et al. 2001). To reduce dog intakes,

321 municipalities should consider how the establishment of free or low cost puppy training

322 programs (potentially mandatory for shelter adoptions) might impact shelter populations. A

323 collaborative effort among multiple community agencies, including animal control, non-profits,

324 and local pet industry businesses should be explored.

325   Another important finding is the enumeration of the substantial unowned cat population

326 in Santa Clara County, two-thirds of which are feral. Also notable is that the majority of

327 unowned cats entering the animal shelters in the study were arguably unsuitable for adoption,

328 with over 50% being feral or unweaned kittens. Such cats are often quickly euthanized.

329 Preventing such input defies simplistic solutions, because although 93% of cat owners were

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330   willing to have their own pets surgically sterilized, it is unrealistic to expect the 7% of the

331   population that feeds an average of 3 stray cats to assume the hundreds of dollars necessary to

332   surgically alter these cats.

333   Conversely, the cost of not altering the cats is to add 3.5 kittens per year for each stray

334   female, which at the cost to a shelter of approximately $250 per cat would cost a shelter almost

335   $900 in husbandry expenses for those 3.5 kittens; were they not sheltered, the kittens would be

336   expected to have 75% mortality (Table 1). The underscores why low-cost spay and neuter

337   programs directed to reducing the un-owned and feral cat populations continue to be integral to

338   not only reducing cat mortality at the shelters, but also to managing the cost to the various

339   municipalities to handle and house the stray cats. Santa Clara County's contribution of $45 to

340   alter a stray cat under its separate feral spay/neuter program created an immediate savings of

341   over $200 for just the first litter that permanently results in non-reproducing cats. The county

342   program also subsidized shots, and for a time, FELV testing. The earlier such cats can be

343   sterilized, the greater the potential savings to municipalities. The savings would be expected to

344   grow over additional years. Moreover, under all plausible scenarios shown in Table 2 the

345   voucher program would have resulted in a net savings in expenditure.

346   If stray cat-feeding citizens can be convinced through public education to avail

347   themselves of population control options by making them more affordable and they are provided

348   with instructions and resources as to how to accomplish this activity, the savings in costs and

349   lives will be substantial. This study shows approximately 93% of county residents did not make

350   an effort to sterilize unowned cats. Only 5.5% of the unowned but fed cats were surgically

351   sterilized. Efforts should be focused on removing barriers and finding ways to encourage those

352   who feed free-roaming cats to take this important step. Because the study shows that 62% of

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353 unowned but fed cats are fed in people's yards, efforts should be intensified to sterilize cats

354 living in close proximity to homes, rather than less accessible colonies.

355   This study's limitations include the assumption that the participating individuals are

356 representative of the county's population. Interviews were conducted via telephone, with the

357 non-telephone-owning segment of the county excluded by design, and to the extent that this

358 subgroup differs in their pet ownership and practices the findings cannot be generalized to them.

359 However, calls were made to each zip code in the county, and the number of respondents

360 completing the survey in each zip code, were proportionate to their share of the county

361 population. Although the finding that shelter intake declined in association with the inception of

362 the voucher program, the presence of extraneous (confounding) factors associated both with time

363 and shelter intake cannot be ruled out, including migration into and out of the county (although

364 the human population actually increased during the study period). At the time of the study, two

365 additional smaller shelters existed in the county: a county facility in San Martin, which served

366 the 5% of the population not living within cities, and a city facility in Palo Alto, which only

367 served Palo Alto residents; these shelters were not expected to have any meaningful impact on

368 intake changes in the shelters in this study.

369   In conclusion, this study demonstrates the financial and societal value of instituting a

370 low-cost voucher program on a county-wide scale. Although the parameters utilized in the

371 projections and models in this research (e.g., fecundity and mortality) will vary, perhaps

372 substantially, from county to county, they are realistic and based on published observations. It is

373 therefore likely that the qualitative – if not the precise quantitative -- benefits of the voucher

374 program in Santa Clara County will be of significance if incepted elsewhere.

375 **Acknowledgements**

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396   cats in a California animal Shelter. *Journal of Applied Animal Welfare Science* 5:29-42.

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418   Animal Factors Related to Relinquishment of Dogs and Cats in 12 Selected Animal

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426   State of California. (2009a). Table B-3: Total population of California counties as of July 1.

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429   State of California. (2009b). Table B-5: Population and percent distribution by race and Hispanic

430   origin, California, Census 2000. Available at

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433   U.S. Census Bureau. (2012). State & County QuickFacts. Santa Clara County, California.

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437   examination. *International Journal of Liability and Scientific Enquiry* 3:291-319.

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439 **Footnotes**

440

441 [1] Scientific Telephone Samples, Foothill Ranch, California

Table 1 (on next page)

Information used in modeling cat population dynamics from 1994 to 2005 if no spay/neuter voucher program had been initiated in Santa Clara County, California.

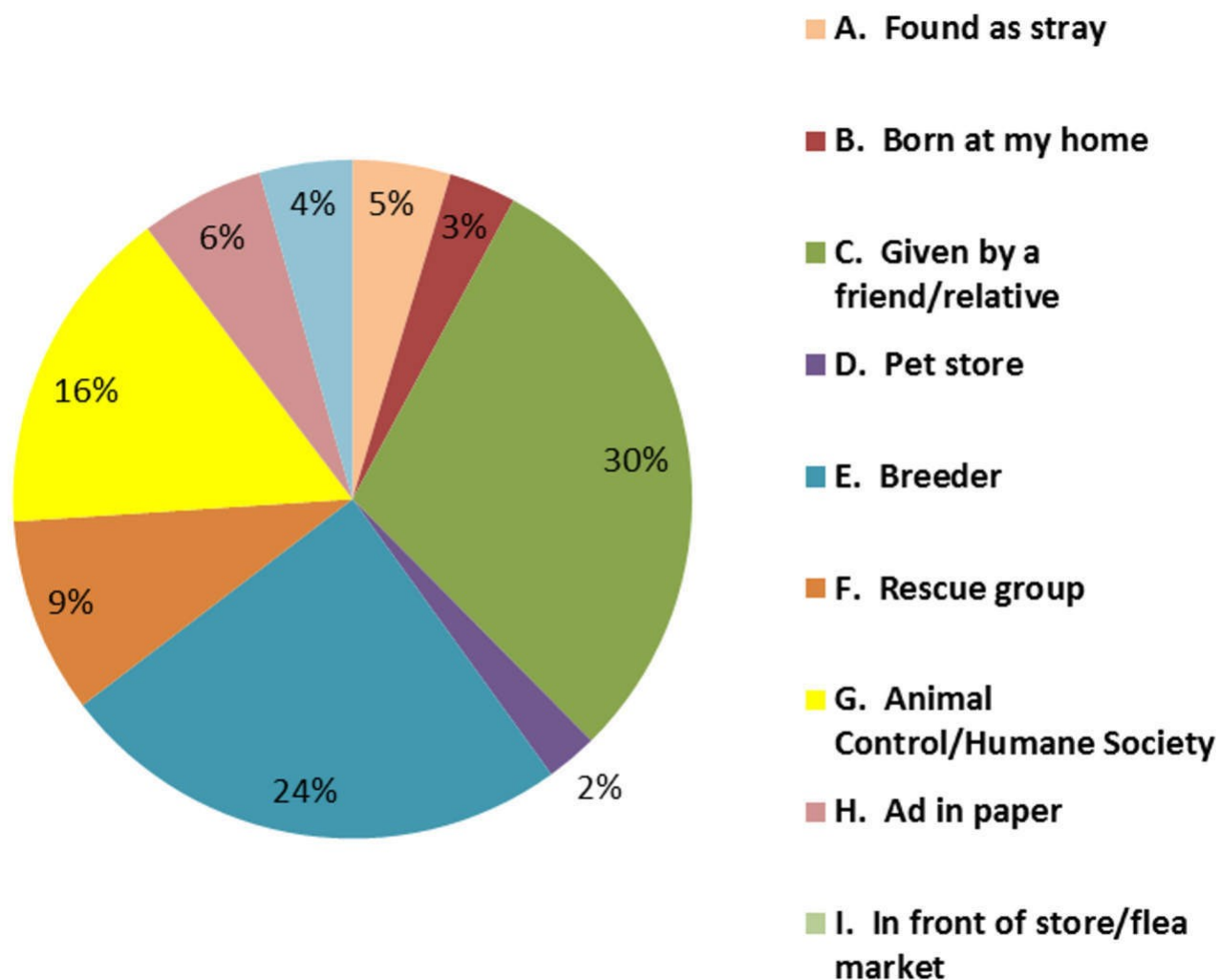| Parameter	Owned cats	Unowned cats	References
Kittens/litter	4.25	3.6	Pedersen, 1991; Scott et al., 2002
Kitten mortality rate (%)	30	75	Jemmett and Evans, 1977; Nutter et al., 2004; Scott et al., 1978
Life expectancy (years)	12	4.7	Levy et al., 2003; New et al. 2004
Litters per female per year	2.1	1.4	Pedersen, 1991, Nutter et al., 2004; Levy et al., 2003; Scott et al., 2002
Percent female	55	45	Levy et al., 2003
Sexually intact (%)	14	94.5	1993 and 2005 surveys
Surrendered to shelter (%)	3.0	7.3	1993 survey and shelter statistics

Table 2

Projected impact of hypothetical absence of the 12 year spay/neuter program on cat populations, shelter intake, and municipal cost in Santa Clara County.

Median and the 5th and 95th percentiles (in parentheses) are reported (x $1,000).

Percentage of surgeries performed on owned cats	Additional number of owned cats	Additional number of stray cats	Cats voluntarily surrendered to shelter	Cats brought in by field service	Total additional shelter cat intake	Cost to shelter for additional surrendered and stray cats
20	193	265	6	20	25	$6,333
	(110, 388)	(131, 593)	(3, 12)	(10, 44)	(13, 55)	(3,242, 13,817)
30	226	181	7	13	20	$5,034
	(140, 412)	(98, 367)	(4, 13)	(7, 27)	(11, 40)	(2,867, 9,893)
40	239	124	7	9	16	$4,078
	(159, 398)	(73, 226)	(5, 12)	(5, 17)	(10, 28)	(2,549, 7,089)
50	242	84	7	6	13	$3,351
	(173, 368)	(54, 138)	(5, 11)	(4, 10)	(9, 21)	(2,282, 5,291)
60	241	55	7	4	11	$2,823
	(180, 342)	(38, 85)	(5, 10)	(3, 6)	(8, 17)	(2,035, 4,135)
70	236	35	7	3	10	$2,411
	(182, 319)	(25, 50)	(5, 10)	(2, 4)	(7, 13)	(1,814, 3,324)
80	231	20	7	1	8	$2,099
	(182, 303)	(15, 27)	(5, 9)	(1, 2)	(6, 11)	(1,625, 2,792)

Figure 1

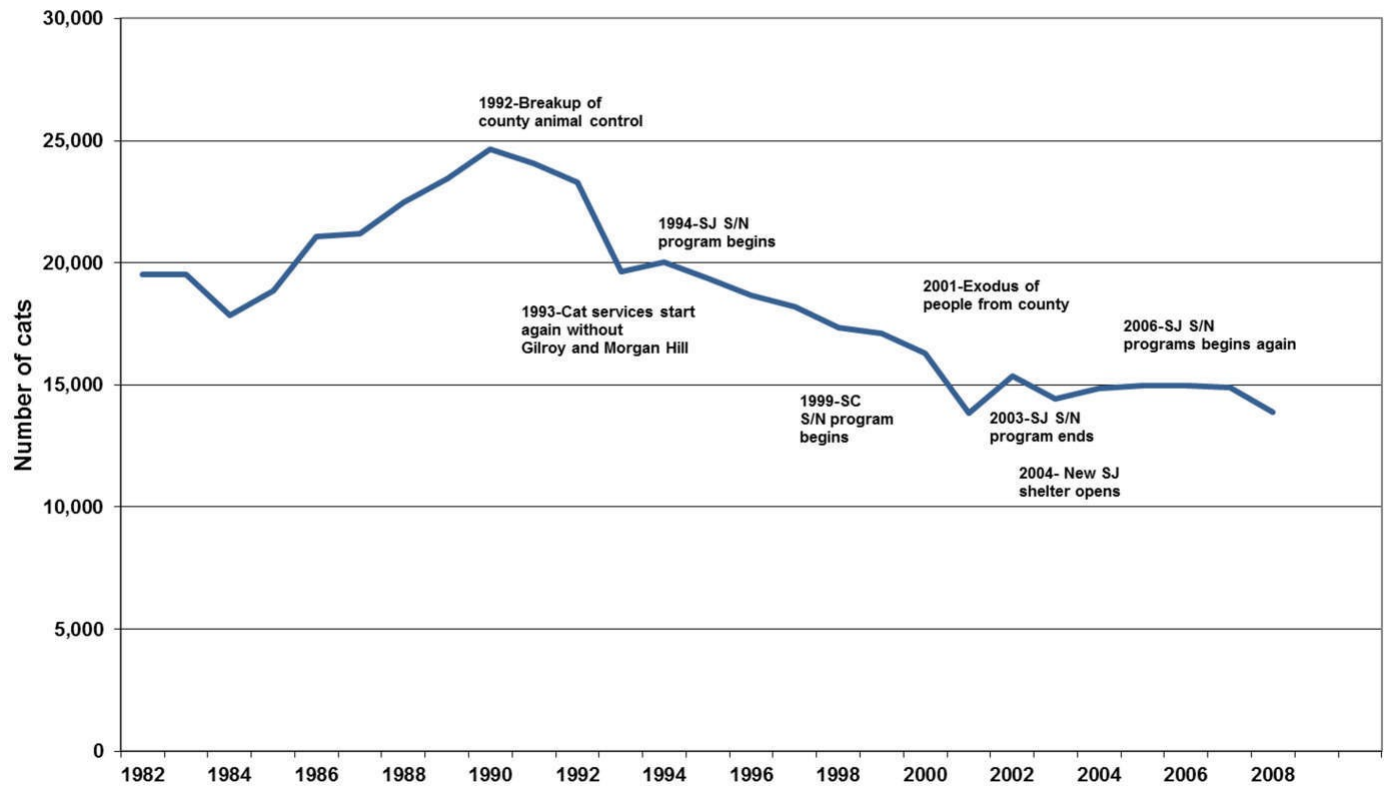Source of acquisition of dogs from Santa Clara County survey, 2005.

Legend:
- A. Found as stray
- B. Born at my home
- C. Given by a friend/relative
- D. Pet store
- E. Breeder
- F. Rescue group
- G. Animal Control/Humane Society
- H. Ad in paper
- I. In front of store/flea market

Pie chart values: 5%, 3%, 30%, 2%, 24%, 9%, 16%, 6%, 4%

Figure 2

Regression analysis of intake of dogs at shelters in Santa Clara County (r = 0.95) and San Mateo County (r = 0.97) over time (1990 – 2005).
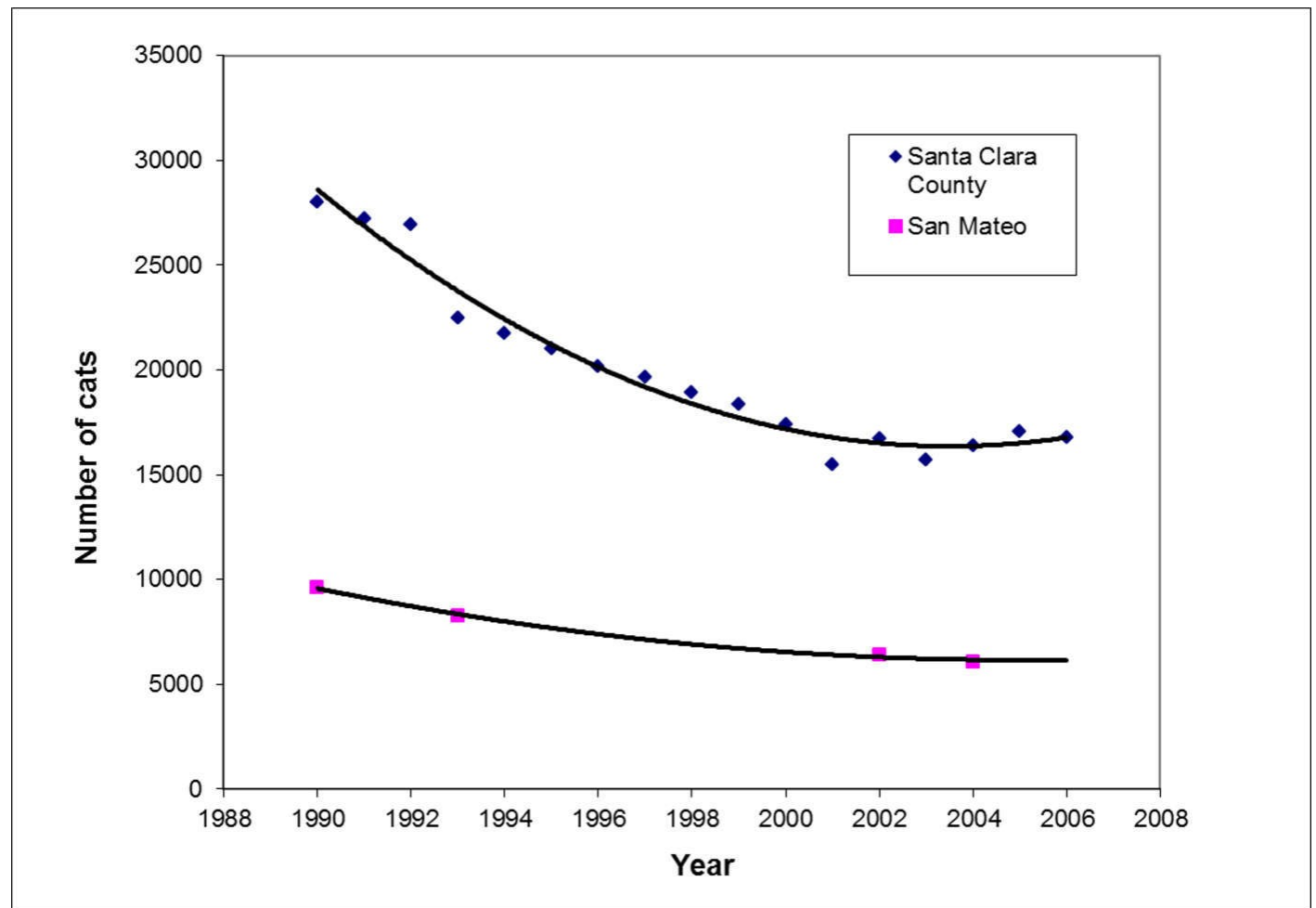
Figure 3

Secular changes in cat intakes in Santa Clara County, 1982 – 2007, indexed by historically relevant events.

Figure 4

Regression analysis of intake of cats at shelters in Santa Clara (r=0.98) and San Mateo Counties (r>0.99), 1990 – 2006.
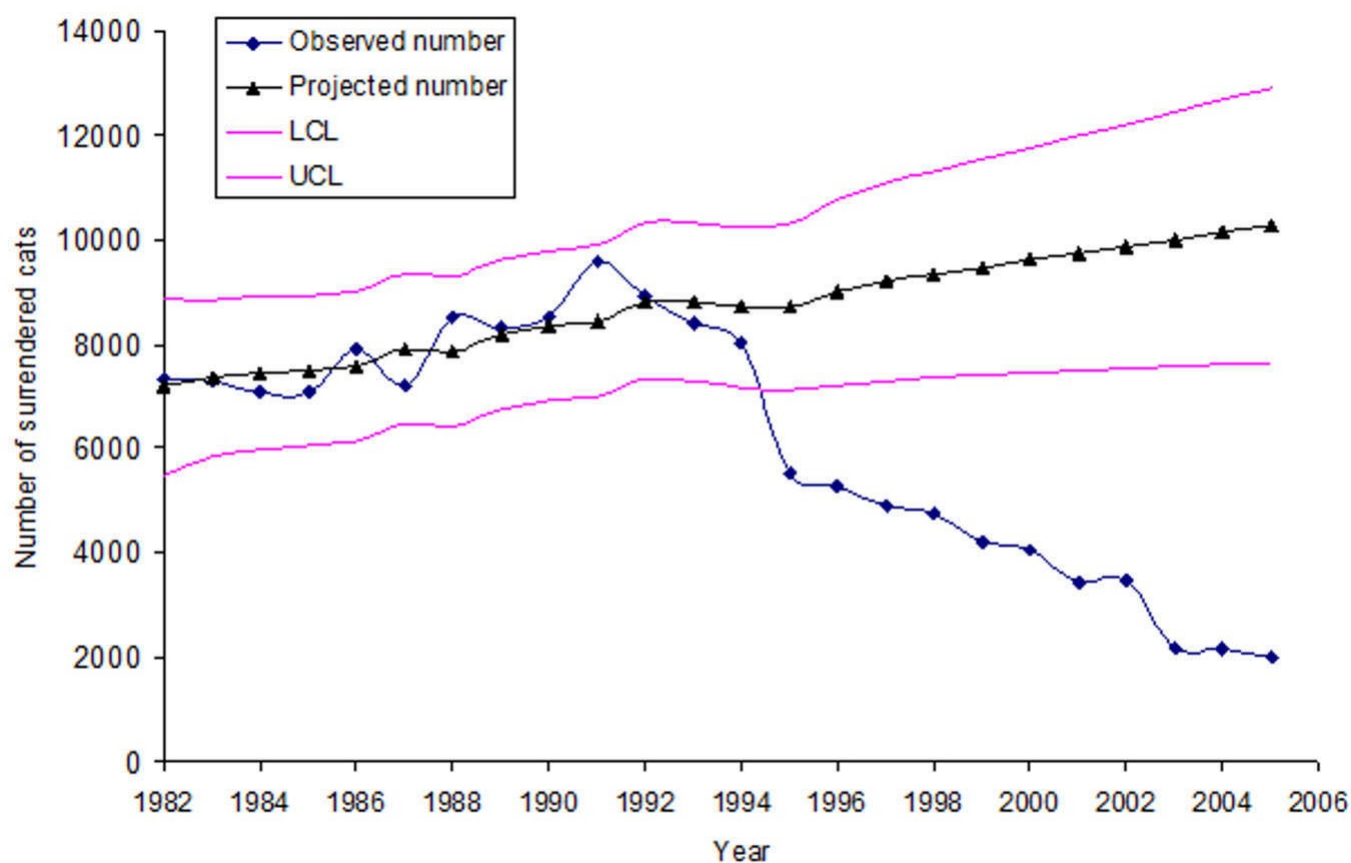
Field services in Santa Clara County ended in 1992; at that time 60% of cats were brought in through field services. Field services resumed in November 1993 in some cities.

Figure 5

Observed numbers of cats surrendered to the shelters in Santa Clara County versus autoregressive integrated moving average (ARIMA) projected numbers of surrendered cats.

Figure uses the 1982-1993 data (before the launch of the spay/neuter voucher program) shelter data. The lower (LCL) and upper (UCL) 95% confidence limits of the ARIMA projection are also presented.

Figure 6

Observed numbers of cats brought to the shelters in Santa Clara County by the field service versus the autoregressive integrated moving average (ARIMA) projected numbers of cats.

Figure shows cats brought in by field service using the 1982-1993 (before the launch of the spay/neuter voucher program, shelter data). The lower (LCL) and upper (UCL) 95% confidence limits of the ARIMA projection are also presented.