FOOD ITEM USE BY ISLAND FOXES ON SAN NICOLAS ISLAND: 2015-2017

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EXECUTIVE SUMMARY

Patterns of food item use by island foxes (*Urocyon littoralis dickeyi*) were assessed on San Nicolas Island (SNI) during 2006-2012. Food item use was further examined during 2015-17. Objectives for this latter effort were to:

(1) determine whether seasonal or annual patterns of food use differed from the 2009-2012 results,

(2) determine whether any differences in current food use patterns might be related to recent events, particularly the decline of ice plant (*Carpobrotus spp.*) and initiation of habitat restoration efforts, and

(3) use these results to develop recommendations for the management and conservation of island foxes on SNI and other islands.

We analyzed 492 scats collected from October 2015 to September 2017. Foxes on SNI continued to exploit a variety of foods with over 20 different items identified. Foraging patterns of foxes varied among seasons, probably as a function of season-specific differences in item availability. In annual diets, 13 items occurred with a frequency ≥ 10% including deer mice (*Peromycus maniculatus*), birds, various beetles, insect larvae, Jerusalem crickets (*Stenopalmatus spp.*), silk-spinning sand crickets (*Cnemotettix spp.)*, European earwigs (*Forficula auricularia*), European garden snails (*Helix aspersa*), and fruits of prickly pear cactus (*Opuntia spp.*), ice plant, and Australian saltbush (*Atriplex semibaccata*). Use of non-native items continued to be high on SNI, where foxes may be at least partially dependent on these items. However, in the final year of our study, the frequency of occurrence of European garden snails and ice plant fruit was lower than in any other year. It is unclear whether this is related to the recent drought-related decline in ice plant on SNI.

The following recommendations are offered:

(1) continue to protect and restore natural habitats to increase the abundance and diversity of native foods for foxes, which in turn will help increase fox population security by ensuring more stable food supplies during resource declines associated with cyclic and stochastic events or climate change,

(2) when reducing or eliminating non-native species used as foods by foxes, do so gradually while concomitantly enhancing or restoring native food items,

(3) because of habitat and fox population changes, monitor food item use periodically to identify changes in foraging patterns and adjust management strategies accordingly, and

(4) consider monitoring the abundance of certain key foods to better understand the dynamics between resource availability and fox abundance.

INTRODUCTION

Island foxes (*Urocyon littoralis dickeyi*) on San Nicolas Island (SNI) are listed as Threatened by the state of California and are a Federal species of conservation concern (U.S. Navy 2010). Due to inherent space and resource limitations associated with an insular environment, this population is relatively small and therefore vulnerable to extinction. Thus, annual monitoring of population demographics and ecological attributes that can influence these demographics is warranted to help provide early warning of population declines that could lead to extinction.

Food item use by foxes is an ecological attribute of acute interest to managers on SNI. This attribute is significant because the availability of foods can fluctuate markedly depending upon environmental conditions, particularly annual precipitation (e.g., Cypher et al. 2017). When food resources become limiting, detrimental effects such as reduced production of young, reduced physical condition, deaths from starvation, and population decline have all been observed among foxes on the island (F. Ferrara, U.S. Navy, personal communication). If these effects are sufficiently prolonged and severe, the population could experience a bottleneck situation where it is further imperiled by very small size and loss of genetic diversity (Frankham et al. 2017). Such an event appears to have occurred at least once previously on SNI in the 1970s when the number of foxes may have been as low as 20 individuals (Coonan et al. 2010).

Historic events on SNI likely have profoundly affected the types and dynamics of foods available to foxes. In the 1800s, sheep were brought to the island and at one time exceeded 30,000 in number (Schoenherr et al. 1999). Severe over-grazing by the sheep defoliated much of the island and caused severe erosion. Thus, many native fruit-producing plant species were eliminated or significantly reduced, as was food and cover for animal prey used by the foxes (e.g., mice, lizards, birds, and insects). Concomitantly, many non-native species colonized SNI, some of which have been used extensively by foxes for food. These include ice plant or sea fig (*Carpobrotus spp.*), Australian saltbush (*Atriplex semibaccata*), myoporum (*Myoporum laetum*), European garden snails (*Helix aspersa*), and European earwigs (*Forficula auricularia*) (Cypher et al. 2014, 2017). Among all of the islands with foxes, fox diets on San Nicolas have the largest proportion of non-native items, and the dependence of foxes on these items is significant (Cypher et al. 2014).

Food item use by island foxes on SNI was examined during 2006-2012 as part of a multi-island analysis (Cypher et al. 2014) and also as part of an assessment of the effects of feral cat removal on foxes (Cypher et al. 2017). Since 2012, several events have occurred that potentially could have affected island fox food use. Beginning in 2008, fox abundance began declining and was particularly marked during the drought conditions experienced from 2011 to 2015. The population declined by about half, which may have reduced intra-specific competition for foods. Coincident with the drought, mortality of ice plant on SNI has been high. This could have impacted not only the availability of ice plant fruits, but also that of European garden snails that are commonly found on the ice plant. Additionally, ecological restoration activities recently were initiated on SNI in an effort to restore native communities and improve habitat quality. Over 30,000 native plants have been propagated and planted, including one (*Opuntia spp.*) that produces abundant fruits that are readily consumed by foxes (F. Ferrara, U.S. Navy, personal communication). All of these events could have influenced patterns of food use by foxes.

Additional island fox scats were collected during 2015-17 and analyzed. The goal of this project was to further examine seasonal and spatial patterns of resource use by island foxes with specific objectives being to:

1. determine whether seasonal or annual patterns of food use differed from the 2006-2012 results,
2. determine whether any differences in current food use patterns might be related to recent events, particularly the decline of ice plant and habitat restoration efforts, and
3. use these results to develop recommendations for the management and conservation of island foxes on SNI and other islands.

STUDY AREA

SNI comprises 5,896 ha and is located in the Pacific Ocean ca. 100 km off the coast of southern California (Fig. 1). The island largely consists of an elevated sandstone plateau with steep slopes dropping down to the shoreline (Schoenherr et al. 1999). Maximum elevation is 277 m. Climate on the island is relatively arid with annual precipitation averaging ca. 20.0 cm (C. Drost, USGS, unpublished data).

SNI is managed by the U.S. Navy and is used for missile testing and other military support activities (U.S. Fish and Wildlife Service 2009). The island is closed to the public; access is limited to Navy personnel, federal civil servants, and contractors. Large portions of the island are regularly closed due to military operations and to protect sensitive environmental and cultural sites.

Much of the island is sparsely vegetated due to a combination of arid conditions and the persisting effects of past overgrazing by domestic sheep (US Navy 2010). SNI has 139 native plant species (Schoenherr et al. 1999). Primary vegetation communities are mixed coastal scrub, barren or sparsely-vegetated badlands, and grasslands dominated by non-native Eurasian annual species. The non-native grasslands and barren or sparsely-vegetated areas make up about 36% of the land cover on the island. Coastal scrub covers an additional 42%, but much of this community is degraded by encroachment of non-native species (Junak 2008). Dominant plants include coastal goldenbush (*Isocoma menziesii*), giant coreopsis (*Leptosyne gigantea*), bush lupine (*Lupinus albifrons*), coyote brush (*Baccharis pilularis*), and non-native grasses, particularly slender wild oats (*Avena barbata*), ripgut brome (*Bromus diandrus*), and foxtail barley (*Hordeum murinum*). Less common, but important, native shrubs include California sagebrush (*Artemisia californica*), buckwheat (*Eriogonum grande*), California boxthorn (*Lycium californicum*), prickly-pear cactus, and coastal cholla (*Opuntia prolifera*). Among terrestrial vertebrates, only two species of mammal (deer mouse [*Peromyscus maniculatus*] and San Nicolas Island fox), three species of herpetiles (Island night lizard [*Xantusia riversiana*], side-blotched lizard [*Uta stansburiana*], and southern alligator lizard [*Elgaria multicarinatus*]), 15 species of breeding land birds, and five species of sea birds reside on SNI (Schoenherr et al. 1999).

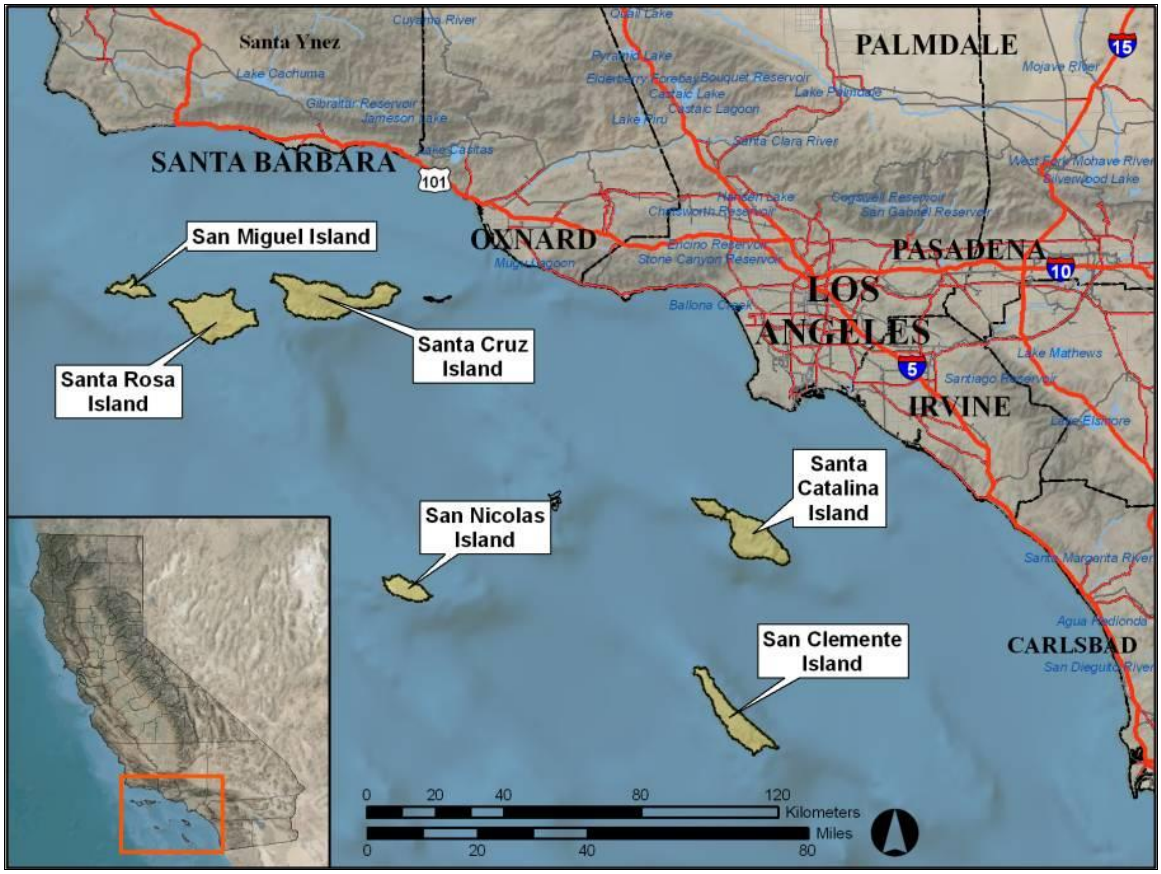

Figure 1. Channel Islands study area, Santa Barbara, Ventura, and Los Angeles counties, California.

METHODS

Island fox scats were collected monthly throughout SNI from July 2015 to September 2017 by several biologists working on the island. Scats were collected during each of 4 seasons: Fall (October-December), Winter (January-March), Spring (April-June), and Summer (July-September). Scat samples were collected into paper bags and allowed to air-dry. After shipping the scats to the Endangered Species Recovery Program (ESRP) field office in Bakersfield, California, the contents of each scat were carefully separated and individual food items within the samples were identified to the lowest taxonomic level possible. Mammalian remains were identified based on bone and dental fragments and guard hair characteristics. Birds were identified based on feather and foot characteristics. Insects were identified based on exoskeleton characteristics. Fruits were identified based on seed and exocarp characteristics. Items were identified using guides (e.g., Young and Young 1992) or by comparison with reference collections.

Frequency of occurrence of items (FOO; number of scat samples containing diet item x divided by total number of samples) was determined for each seasonal sample (e.g., Fall 2015, Summer 2016) and year. Years were defined as October-September to correspond with annual precipitation patterns and their concomitant effects on annual food item availability. Many items only occurred at low frequencies (<10%), suggesting that such

items were opportunistically encountered and consumed and were not important to the overall diet of island foxes. When comparing item use from the 2006-12 study with the 2015-17 study, items were grouped into six broad categories to match the 2006-12 analyses: deer mouse, bird, lizard, arthropod, snail, and fruit. Shannon diversity indices (*H'*) were also calculated for seasonal and annual diets using the equation:

$$H' = (N \log N - \sum n_i \log n_i)/N$$

where N is the total number of occurrences of all items and n_i is the number of occurrences of item i (Brower and Zar 1984). To calculate percent occurrence of items for each seasonal sample and year of our study, items were grouped into seven broad categories: deer mouse, bird, lizard, arthropod, snail, native fruit, and non-native fruit. Fruits were divided into native and non-native categories for the current analysis because one of objectives of this project was to assess the effects of restoration efforts on foxes, including the planting of native fruit-producing species.

The effects of annual precipitation on island fox foraging patterns were examined using rainfall data compiled and summarized by Charles Drost (USGS, Flagstaff, AZ), covering the period 1948-2017. Total precipitation for each year in which fox scats were collected was determined by summarizing monthly rainfall from July to June. Precipitation on the Channel Islands falls almost entirely during the winter, so the July–June period reflects the precipitation associated with the annual growing season.

RESULTS

ANNUAL FORAGING PATTERNS

During July 2015-September 2017, a total of 636 island fox scats were collected and a subset of 492 scats were subsequently analyzed. The sample size for Summer 2015 was small and therefore the results for this season were excluded from the seasonal analyses, but retained in the annual analyses. Over 20 different food items were identified in island fox scats collected from SNI. These are listed in Appendix A along with their scientific names. Also found were a number of non-food items, many of which likely were ingested incidentally along with food items. Non-food items included grass, twigs, soil, pebbles, and anthropogenic items such as pieces of plastic and fibers from burlap used to cover fox cage traps.

During the study, 13 items occurred with a frequency ≥ 10% in annual fox diets (Table 1). These items were: deer mice, birds, various beetles, insect larvae, Jerusalem crickets, silk-spinning sand crickets, earwigs, terrestrial snails, and fruits of prickly pear cactus, ice plant, and Australian saltbush. The number of items with a frequency ≥ 10% was practically identical for both years. Of the 13 items above, beetles had the highest occurrence in annual diets for both years, while three items were primary foods only for one year or the other; birds and darkling beetles in 2015-16, and prickly pear cactus in 2016-17. Concordantly, annual dietary diversity was very similar for both years (Table 1).

Table 1. Food items occurring with a frequency ≥ 10% in annual island fox diets on San Nicolas Island, CA, during October 2015-September 2017. Non-native items are indicated in red.

Food items / Frequency of occurrence (%)			
October 2015-September 2016		**October 2016-September 2017**	
Coleoptera	72.9	Coleoptera	58.2
Terrestrial snail	53.3	Terrestrial snail	34.9
Deer mouse	34.1	Deer mouse	31.8
Silk-spinning sand cricket	31.8	Earwig	28.0
Ice plant	31.3	Insect larvae	26.4
Earwig	27.1	Silk-spinning sand cricket	23.8
Australian saltbush	19.6	Ice plant	22.2
Insect larvae	15.4	Australian saltbush	18.0
Jerusalem cricket	10.7	Jerusalem cricket	14.9
Bird	10.3	Prickly pear cactus	11.9
H'	**0.93**		**0.96**
Scats	**214**		**261**

For food items grouped into seven categories (Figure 2), arthropods, terrestrial snails, and deer mice were clearly important food items for foxes on SNI. Fruits also were commonly consumed and non-native fruits (e.g., ice plant and Australian saltbush) occurred more frequently than native fruits (e.g., prickly pear cactus and verbena). The proportional use of lizard was similar between years while the use of deer mouse and arthropod increased slightly and the use of bird, European garden snail, and fruit decreased slightly.

SEASONAL FORAGING PATTERNS

During October 2015-September 2017, 13 items occurred with a frequency ≥ 10% in seasonal fox diets (Table 2). These items were: deer mice, lizards, birds, various beetles, beetle larvae, Jerusalem crickets, silk-spinning sand crickets, earwigs, terrestrial snails, and fruits of prickly pear cactus, ice plant, and Australian saltbush. The number of items with a frequency ≥ 10% ranged from five in winter to ten in fall. Concordantly, dietary diversity was highest in fall and lowest in winter, based on the Shannon index (Table 2). Of the 13 items above, beetles, snails, and deer mice were primary foods in all four seasons while three items were a primary food in just one season each: lizards in spring; June beetles in winter; and prickly pear cactus fruits in fall.

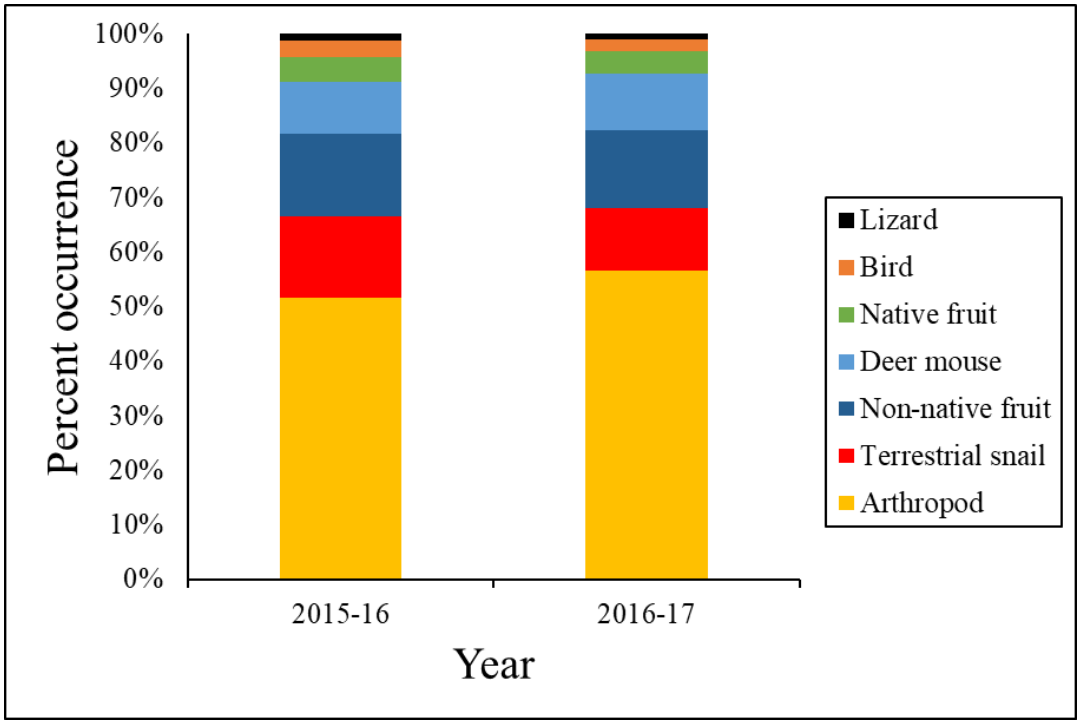

Figure 2. Proportion of food items (grouped into 7 categories) in annual diets of island foxes on San Nicolas Island, CA, from October 2015-September 2017.

Table 2. Food items occurring with a frequency ≥ 10% in seasonal island fox diets on San Nicolas Island, CA, during October 2015-September 2017.

	Food items / Frequency of occurrence (%)							
	Winter		**Spring**		**Summer**		**Fall**	
	June beetle	72.4	Deer mouse	58.9	Ice plant	59.0	Silk-spinning sand cricket	58.6
	Coleoptera	47.6	Earwig	56.7	Terrestrial snail	42.7	Terrestrial snail	54.3
	Insect larvae	46.9	Coleoptera	52.2	Silk-spinning sand cricket	39.3	Coleoptera	52.1
	Terrestrial snail	30.3	Terrestrial snail	48.9	Deer mouse	36.8	Australian saltbush	40.7
	Deer mouse	21.4	Insect larvae	24.4	Coleoptera	35.9	Earwig	35.7
			Ice plant	24.4	Australian saltbush	32.5	Ice plant	27.1
			Bird	14.4	Earwig	26.5	Jerusalem cricket	26.4
			Lizard	13.3			Prickly pear cactus	26.4
			Jerusalem cricket	13.3			Deer mouse	24.3
							Bird	12.1
H'	**0.66**		**0.89**		**0.83**		**0.96**	
Scats	**145**		**90**		**117**		**140**	

For food items grouped into seven categories, arthropods, European garden snails, and fruit were important resources in all seasons (Figure 3). Native fruits collectively were used in low frequencies while non-native fruits, particularly ice plant and Australian saltbush, were important foods in spring and summer. The use of deer mice, lizards, and birds was greatest in spring.

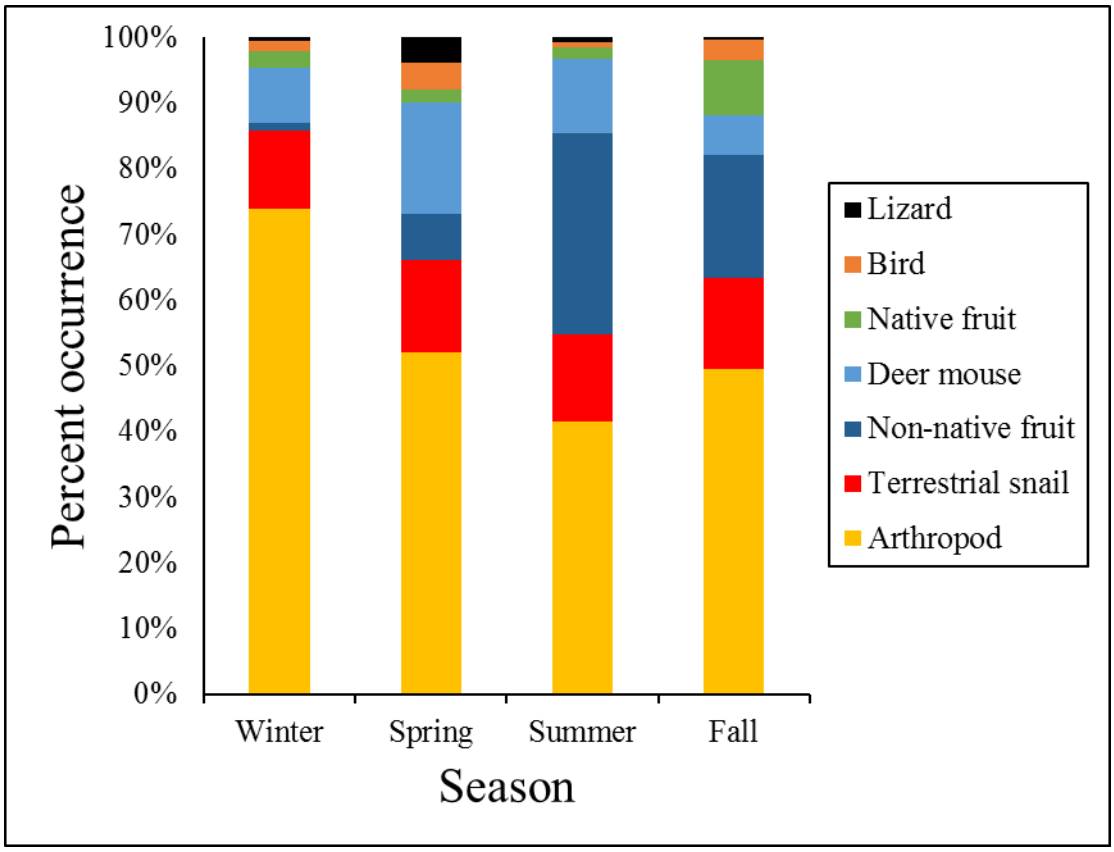

Figure 3. Proportion of food items (grouped into 7 categories) by season for island foxes on San Nicolas Island, CA, during October 2015-September 2017.

USE OF NON-NATIVE ITEMS

Foxes consumed non-native food items in every season and the contribution of these items to annual diets was similar between years (Figure 4). Non-native food items included European earwigs, European garden snails, and fruits of ice plant, Australian saltbush, and myoporum. Additionally, evidence of anthropogenic foods (e.g., fruit sticker, nut, plastic wrapper) was found in six scats.

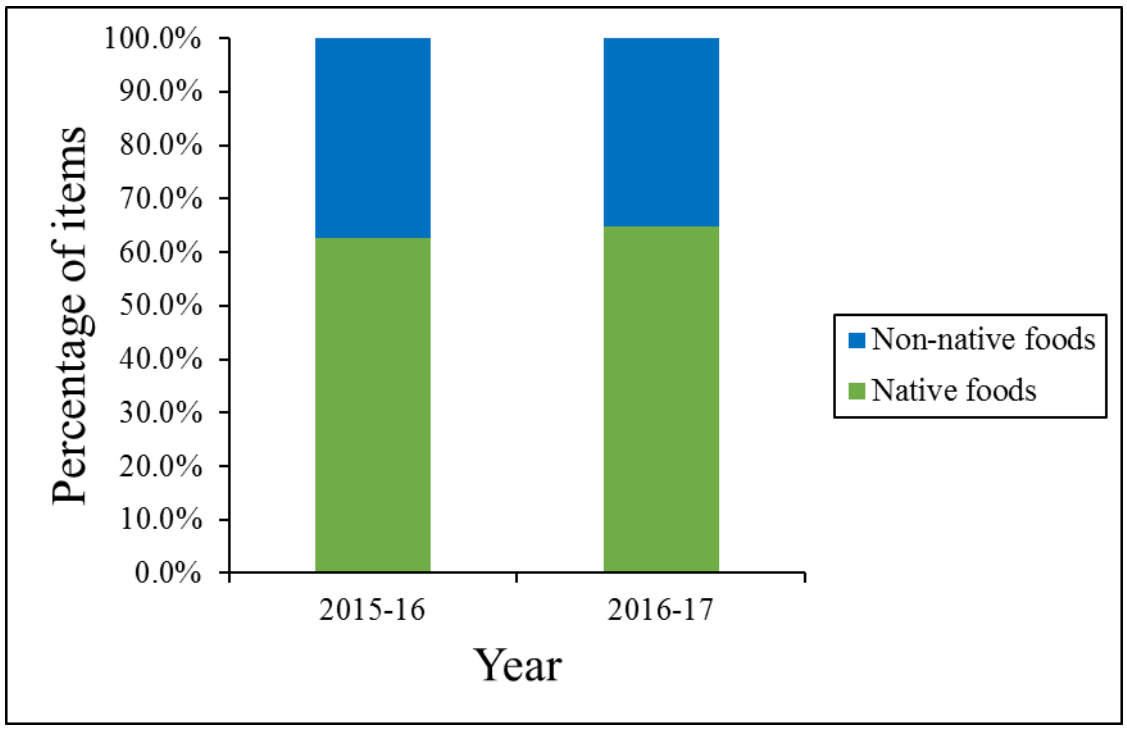

Figure 4. Proportion of native and non-native foods in annual diets of island foxes on San Nicolas Island, CA, from October 2015-September 2017.

Among annual diets, four of the 11 primary items consumed by foxes on SNI were non-native (Table 1). Among seasonal diets, four of the 13 primary items consumed by foxes on SNI were non-native (Table 2). Non-native ice plant fruits were the most frequently occurring item in summer, while European garden snails were the second most frequently occurring item in summer, fall, and annually.

ANNUAL USE OF ITEMS BETWEEN 2006-2012 AND 2015-2017

This project provided two more years of data to supplement a relatively robust data set collected from 2006-12. Food item use by foxes was generally similar between the 2006-12 and 2015-17 results (Table 3, Figure 5). The frequency of occurrence of deer mice in SNI scats remained comparable to the 2006-12 results, particularly the latter years of that study when deer mouse abundance was higher. The use of bird and lizard was also similar to results from the previous study. Use of arthropods remained high and occurred in over 90% of scats. The occurrence of European garden snail was considerably lower in 2015-17 as was the occurrence of fruit. Among fruits, use of ice plant was a bit lower in 2015-17, but use of other fruits was similar to that in 2006-12 (Figure 6). Dietary diversity was similar across years (Table 3).

Table 3. Frequency of occurrence of food items in island fox scats, item diversity, and annual precipitation on San Nicolas Island, CA, during October 2006-September 2012 and October 2015-September 2017.

Year[A]	Frequency of occurrence (%) in fox scats						Item diversity[B]	Precipitation[C]
	Deer mouse	Bird	Lizard	Arthropod	Snail	Fruit		
2006-07	14.8	7.8	7.0	89.5	49.1	58.4	0.63	54.8
2007-08	5.6	4.4	3.6	96.4	48.0	58.8	0.56	174.0
2008-09	11.9	5.9	6.0	88.5	43.5	53.5	0.61	140.9
2009-10	21.3	13.6	11.8	92.7	50.2	70.0	0.67	208.1
2010-11	40.9	13.9	9.1	93.9	44.3	57.4	0.68	293.1
2011-12	38.7	8.5	9.4	92.0	52.4	71.7	0.67	132.8
2015-16	34.1	10.3	4.7	93.9	53.3	52.3	0.65	161.0
2016-17	31.8	6.5	3.1	90.4	34.9	44.1	0.63	269.3

[A]October to September
[B]Shannon diversity index
[C]Total precipitation (mm) from July to June. (Data from C. Drost, United States Geological Survey, Flagstaff, Az.)

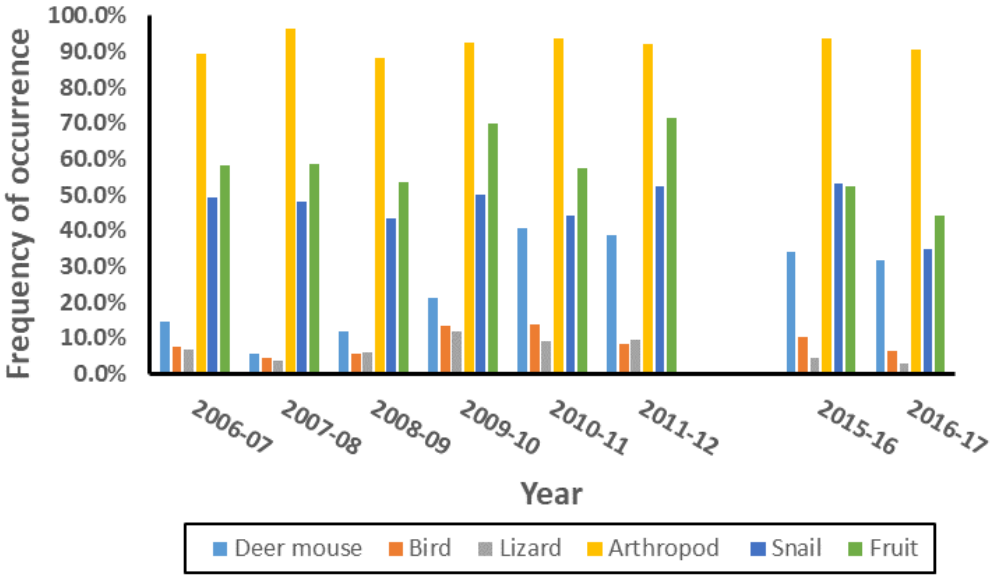

Figure 5. Frequency of occurrence of food items in island fox scats on San Nicolas Island, CA, during October 2006-September 2012 and October 2015-September 2017.

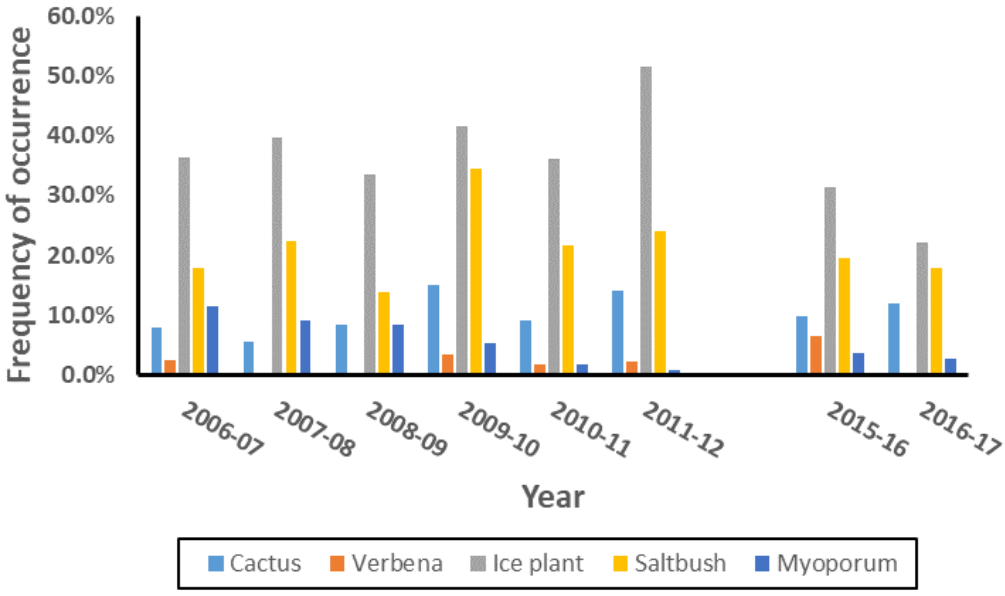

Figure 6. Frequency of occurrence of fruits in island fox scats on San Nicolas Island, CA, during October 2006-September 2012 and October 2015-September 2017.

DISCUSSION

FOOD ITEMS

Island foxes exploit a wide variety of food items including vertebrates, invertebrates, and fruits. The dietary differences observed among seasons on SNI likely reflect a functional response on the part of foxes to temporal variation in food item availability, as has been documented previously on SNI (Cypher et al. 2017) as well as other islands (Cypher et al. 2014).

On SNI, arthropods, snails, fruits, and deer mice continued to be important foods for foxes, as was found in previous work (Cypher et al. 2017). A variety of arthropods, particularly insects, are consumed by foxes. These include various beetles and beetle larvae, Jerusalem crickets, silk-spinning sand crickets, and non-native European earwigs. Clearly, the importance of insects cannot be underestimated, particularly given the depauperate vertebrate communities on the Channel Islands, and the lower diversity of native fruits on SNI compared to other islands with foxes. Non-native snails also are consistently used as are available fruits. Non-native fruits on SNI are particularly important to foxes, as has been documented previously (Cypher et al. 2014, 2017). Deer mice likely are preferred food and also may be important to successful reproduction (Cypher et al. 2014, 2017).

COMPARISONS WITH 2006-12 STUDY

Dietary diversity was similar between all study years, reflecting the generalist food habits of island foxes and the variety of foods used. In the 2015-17 study, island foxes primarily consumed arthropods, snails, fruit, and deer mice, which is consistent with results from the 2006-12 study. Arthropods were the most frequently occurring items in scats in all years reflecting their importance to SNI foxes. The occurrence of snails and ice plant fruits both were lower in 2015-17. The non-native ice plant population on SNI experienced a marked die-back during the drought years from 2013-2015 (F. Ferrara, pers. comm.). This may explain the reduced occurrence of ice plant fruits in the 2015-17 scats. European garden snails commonly inhabit the ice plant, and thus their abundance may have declined as well, as did use of snails by foxes.

NON-NATIVE ITEMS, AND HABITAT RESTORATION

Non-native items continue to be used extensively by foxes on SNI. These items include European garden snails, earwigs, and fruits of ice plant, Australian saltbush, and myoporum. The SNI fox population likely is still dependent to some degree on these foods, and the presence of these items likely increases the current carrying capacity for foxes on the island. Thus, as suggested previously (Cypher et al. 2014), any rapid reduction in the availability of these items, due to anthropogenic or other causes, could result in a concomitant reduction in fox abundance.

Hopefully, current habitat restoration efforts on SNI will have a positive effect on food availability for foxes. In particular, prickly pear cactus is being propagated and out-planted. Prickly pear is used extensively by foxes on the islands where it is present. Ideally, restoration efforts will increase vegetation diversity and habitat complexity, both of which may enhance habitat conditions, and therefore abundance, of vertebrate and

invertebrate prey used by foxes. Increased food abundance and diversity will result in a higher carrying capacity and more stable food supplies. Also, as the number of available items increases, so does the likelihood that some items will remain sufficiently abundant even if other foods decline in availability. In such an event, foxes would have a greater opportunity to switch and exploit alternate resources. Item diversity can help prevent or reduce food-related population declines and the extinction risks associated with smaller populations.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The following conclusions can be drawn from this study.

1. Island foxes are exploiting a variety of food items, including both animal and plant, and including both native and non-native.
2. Annual fox dietary diversity did not vary substantially between the 2006-12 study and the 2015-17 study.
3. Fox foraging patterns from 2015-17 varied among seasons, probably as a result of seasonal variation in the availability of food items.
4. Foxes may prefer certain food items including deer mice, European garden snails, Jerusalem crickets, sand crickets, beetles, earwigs, and fruits of Australian saltbush, ice plant, and prickly pear cactus.
5. Foxes readily exploited non-native food items, including European earwigs, European garden snails, and fruits of ice plant, Australian saltbush, and myoporum.
6. The occurrence of European garden snail and ice plant fruit was the lowest in the final study year (2016-17). This could be a function of the recent die-back in ice plant on SNI.
7. Foxes may be at least partially dependent on non-native food items on SNI, and therefore, the foxes could be adversely impacted by the rapid reduction or removal of these items.
8. Increasing the diversity of available food items may help to increase the security of fox populations by ensuring more stable food supplies during resource declines associated with cyclic and stochastic events or climate change.

RECOMMENDATIONS

Based on the results of this project, the following recommendations are offered:

1. Protect and restore natural habitats to increase fox food supplies

Habitat protection and restoration efforts are in effect on SNI. Such efforts should be continued and enhanced when possible, particularly any efforts that increase native plant

and habitat diversity. Such efforts will increase the abundance and diversity of foods for foxes, which in turn will help increase fox population security through the mitigation of food-related population declines.

2. Exercise caution when reducing or eliminating non-native items

Restoring ecosystem health and integrity on the islands will involve the reducing or eliminating non-native species where practicable. On SNI, where non-native species are being used as significant food items, removal of these species should be conducted cautiously and slowly to avoid adverse impacts to foxes. Ideally, such efforts should be conducted in conjunction with the restoration of native food items to compensate for the loss of the non-native items.

3. Periodically monitor food item use by foxes

Due to recent habitat protections, feral cat removal, restoration efforts, and declines in annual precipitation, habitat conditions on SNI are changing. Accordingly, the diversity and abundance of foods will change with evolving habitat conditions. Food availability also could change with increasing fox numbers and the associated increase in exploitation pressure on food resources. To better understand these dynamics and gather information that may assist in fox conservation, food item use by foxes should be monitored periodically. Annual monitoring would be ideal, but if funding is limited, longer intervals would still be beneficial.

4. Monitor availability of food resources

Because island foxes use a diversity of foods, monitoring the availability of all food items would not be practical or necessary. However, it might be helpful to annually assess the abundance of certain key foods, such as deer mice, beetles, Jerusalem crickets, sand crickets, and fruits of prickly pear cactus and ice plant. Such monitoring probably could be designed in a manner as to not be overly costly or time-consuming. Monitoring the availability of select key items could provide early warnings of food shortages associated with reductions in one or more items. Such monitoring concomitant with on-going fox population monitoring would provide insights into the dynamics between resource availability and fox abundance.

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APPENDIX A. FOOD ITEMS FOUND IN ISLAND FOX SCATS FROM SAN NICOLAS ISLAND DURING OCTOBER 2015-SEPTEMBER 2017. ITEMS IN RED ARE NON-NATIVE.

	Food item	Scientific name
Vertebrates	Pinnipeds	Family Otariidae or Phocidae
	Deer mouse	*Peromyscus maniculatus*
	Birds	Species unknown
	Lizards	Species unknown
Insects	Beetle and beetle larva	Order Coleoptera
	Darkling beetle	Family Tenebrionidae
	European earwig	*Forficula auricularia*
	Field cricket	Family Gryllidae
	Grasshopper	Order Orthoptera
	Jerusalem cricket	*Stenopalmatus spp.*
	Scarab (ex. May beetle, June beetle)	Family Scarabaeidae
	Silk-spinning sand cricket	*Cnemotettix spp.*
Other invertebrates	Crustacean	Crustacea
	European garden snail	*Helix aspersa*
Plant fruits	Australian saltbush	*Atriplex semibaccata*
	Ice plant	*Carpobrotus spp.*
	Myoporum	*Myoporum spp.*
	Prickly pear cactus	*Opuntia spp.*
	Verbena	*Abronia spp.*