Anaho Island, Nevada: A Relict Area Dominated by Annual Invader Species

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An increase in the presence and dominance of cheatgrass and red brome has been evident in more arid portions of the western Great Basin (Hunter 1990a, 1990b; Young et al. 1987). Beatley (1966) noted the presence of cheatgrass above 5,100 ft and red brome at 3,600–5,100 ft at the Nevada Test Site in southern Nevada. They were primarily found on disturbed areas and red brome did not appear to be aggressive in the region. Recently the presence of these species has expanded to cover most of the Nevada Test Site (Hunter 1990a, 1990b). These species are now found in undisturbed communities and red brome is more dominant than in previous surveys. In 1988, introduced annuals were 81% of the ephemeral vegetation on disturbed areas and 61% on pristine areas on the Nevada Test Site. A similar increase has been noted for cheatgrass in the Lahontan Basin (Young and Tipton 1990).

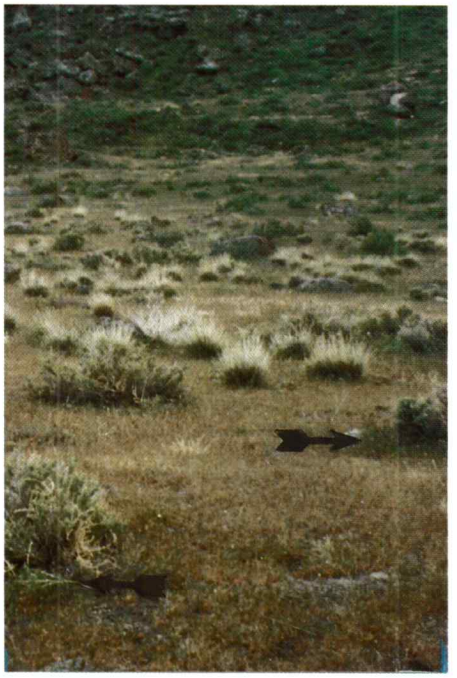

Fig. 1. *General view of vegetation on the north side of Anaho Island on 18 April 1990. The bunchgrass is desert needlegrass, the shrubs are primarily shadscale, and the interspaces are dominated by red brome and filaree, with a scattering of Russian thistle skeletons. Arrows point to cheatgrass surrounding the shrubs.*

Similar changes have apparently occurred on Anaho Island in northwestern Nevada. At 750 acres in size, Anaho is the largest island in Pyramid Lake, and rises to about 540 ft above lake level. Pyramid Lake is the remnant of the pluvial Lake Lahontan that once covered much of northwestern Nevada and portions of southern Oregon. Precipitation for the Pyramid Lake area is 5 inches per year, and temperatures on Anaho Island are probably buffered by the surrounding water. The island was mentioned several times by Israel Cook Russell (1885) in his description of Pyramid Lake. Russell found the island of interest as suggested from the following quote: "The island, although without fresh water, and but scantily clothed with vegetation, is one of the most instructive points about Pyramid Lake, and will well repay a visit from the geologist or the artist." Anaho Island was established as a National Wildlife Refuge in 1913 to protect bird populations (especially pelicans) that depend on the island for safe nesting sites. As Beazley (1977) suggested, given the lack of resources and abundances of rattlesnakes, the island has remained relatively undisturbed.

The long history of minimal impact

Fig. 2. *The "halo" of greener grass around the shrubs is cheatgrass (18 April). Again, red brome dominates the interspaces. The arrow designates the cheatgrass halo.*

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Fig. 3. *A closeup of the base of the slope pictured at the top of figure 1 reveals a dense cover of cheatgrass (18 April).*

by humans makes Anaho Island an interesting place to view vegetation dynamics in response to the establishment of annuals. There is no record of the island being grazed or intentionally burned since the turn of the century. In 1893, a brief description of Anaho Island was given by Vernon Bailey of the Smithsonian Institute (on record with the U.S. Fish and Wildlife Service, Fallon, Nevada). In the report, Bailey mentions that, "A few goats live on the island." Woodbury (1966) found the remains of sheep during his biological survey of the island. The only mammal he found on the island was the deer mouse. We traveled to Anaho Island on 18 April and 30 September 1990, with personnel from the U.S. Fish and Wildlife Service; pictures were taken and vegetation sampling was conducted.

Current Vegetation

To quantify vegetation, 20 plots were sampled along a 300-foot transect randomly located in the area depicted in Figure 1. This sample location is on the northwest side of Anaho Island and located above the high water line of the 19th century lake level. Thus, we sampled areas that had not been disturbed by relatively recent fluctuations in the lake level. Each plot was subdivided into 16, 8 by 16-inch subplots, and within each subplot, percentage cover by species was estimated. We averaged the subplots to obtain an estimate of percentage cover by species along the transect. Sampling was conducted on the 18 April visit.

Current vegetation includes native species such as desert needlegrass, shadscale, Sandberg's bluegrass, and four-wing saltbush. However, the dominants in terms of group cover were the introduced species red brome and filaree. Percent cover was 9 for red brome, 3 for filaree, 3 for shadscale, and less than 1 for other species. The dominance of red brome is shown in Figures 1 and 2. Filaree is less conspicuous, but is also common in the interspaces.

Cheatgrass dominates the more favorable microsites on the north end of Anaho Island. The "halo" of greener vegetation around the shrubs in the foreground of Figure 1 is primarily cheatgrass. A closer view of the halo appears in Figure 2. Sites overwhelmed by cheatgrass are shown in Figures 3 and 4. The picture in Figure 3 was taken just below the rocky slope in the upper left corner of Figure 1, and Figure 4 is a rocky location on the east side of the island. Presumably, runoff from the rocky slopes increases the available moisture just below the slope even in the third year of a drought. We also noted that cheatgrass occurred around the edges of large boulders. Again we assume that water-shedding by the boulders increased available moisture around the edges. A similar pattern of dominance by annuals was observed over most of the rest of the island. The degree of annual grass dominance is suggested by the light color of the vegetation depicted in Figure 5.

There was a tendency for litter buildups to occur in the interspaces. In a number of microsites there was an accumulation of up to 1 inch of litter (Figure 6). The accumulation of litter was greater than might be expected in a perennial grass community in this rainfall regime. This may be related to absence of herbivores.

Past Vegetation

Unfortunately, we could find no detailed records of vegetation on Anaho Island prior to the thesis of

Fig. 4. *Closeup of a cheatgrass-dominated site on the east side of the island (30 August).*

Fig. 5. *View of north side of Anaho Island on 30 August 1990. Coloration reveals the extent of annual grass dominance.*

Woodbury (1966). He divided the island into 5 areas and rated plant species on a scale of 0 (absent) to 4 (very common). In the area we sampled he listed shadscale, four-wing saltbush, and spiny hopsage as very common. Russian thistle, and cheatgrass were common to occasionally very common. However, he did not list red brome as present on the area we sampled, and in fact found this species on only 2 of his 5 designated areas on the island. Red brome was listed as uncommon to common where it occurred. These results are consistent with other reports around the western Great Basin at the same time.

Filaree and Russian thistle do not appear to have changed in abundance since Woodbury (1966) surveyed the vegetation in 1964. Red brome appears to have replaced cheatgrass as the dominant bromegrass over large areas of the island. Several native annuals listed by Woodbury (1966) as common in our sample area were not seen during our survey.

Implications

Areas that have been minimally impacted by human activities are of interest because they can serve as reference points for any changes in the dominance of annuals. Anaho Island would appear to be an ideal location for studying vegetation trends where direct human disturbance has been infrequent. Pelican nesting areas are the eastern shoreline, and there is no evidence the birds use the remainder of the island. Thus, they are not a direct source of disturbance on most of the island, but they may carry seeds to the nesting area in from the mainland shoreline. It is possible that the introduction of competitive annuals may actually represent a major disturbance. Although plants of desert needlegrass are evident on Anaho Island (Figure 1), we could not find evidence of either seedlings, or smaller plants of this species in the sampling area. Additionally, Russian thistle is still present as indicated in Figures 1–3. This species is generally considered a primary colonizer after disturbance (Young and Evans 1972), yet Anaho Island appears to have had minimal disturbance during this century (except for the invasion of annuals). The surrounding shoreline of the mainland has a full complement of the native herbivores for the region and has been continuously grazed by livestock throughout the century. We observed the same annual species to be present on the mainland but without the dominance exhibited on the island. A major factor in the difference appears to be the herbivory on the shoreline that is absent on the island.

The invasions of *Bromus* species into the Great Basin are generally well documented (Mack 1981; Morrow and Stahlman 1984). Russian thistle occurred in much of the western U.S. by the turn of the century (Young and Evans 1977), but the introduction and spread of red brome was not well documented until the early 1960's (Hunter 1990a, 1990b). At least in the case of cheatgrass and Russian thistle, the seeds were introduced as contaminants in crop seeds (e.g., Mack 1981) but the period of introduction coincided with the settling of the western U.S. During this period, excessive grazing, road building, farming of marginal lands, and general expansion of the human population all probably contributed to the rapid spread of these species. The evidence from Anaho Island and the Nevada Test Site suggests these introduced species are more competitive than the native perennials, even if human and livestock impacts on the site are minimal. This competitive ability has been documented in

Fig. 6. *A buildup of litter from the annual species is suggested in this photo.*

other studies from the region (Billings 1990, Melgoza et al. 1990). The presence of significant disturbance does not appear to have been a necessary precursor for either the establishment, or the development of dominance of annual grass on the island. It appears that the absence of disturbance will not favor a return to dominance of native species.

Hunter (1990a) concluded that red brome and cheatgrass will slowly reduce populations of native ephemerals on the Nevada Test Site. This will occur through shading, competition for water and nutrients, and changes in fire regimes. Increasing fire frequency (and a potential change in the timing of fires) from the increased cover of annuals has a substantial negative impact on the perennials (Young et al. 1987). Similar changes appear to be occurring on Anaho Island. Annuals are now sufficiently dominant on the island for a fire to potentially eliminate much of its remaining perennial salt desert vegetation, and the chances of a return to pristine conditions appear minimal.

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