Stress Tolerance and Invasive Spread of *Arundo donax* along California Coastal Areas. Scott Steinmaus, Horticulture and Crop Science Department, California Polytechnic State University San Luis Obispo

Giant reed (Arundo donax) is an aggressive invasive grass along riparian habitats that spreads primarily by stem and rhizome fragmentation. It has been especially successful in southern California along flood control basins such as the Santa Ana River corridor from Riverside, California down to its estuary near Newport Beach, California. Previous research has identified the bioclimatic variables necessary to accurately predict its extensive spread in southern California with a base temperature parameter of 12.7C and a base moisture parameter of -1.65 MPa (about 6% volumetric water content) (Graziani and Steinmaus, 2009). Giant reed populations have become established along the beaches especially south of the Santa Ana River estuary such as Carlsbad and nearby beaches. Rhizome fragments of these populations had clean edged cuts suggesting they had been managed by some mechanical form of control. Helicopter recognizance mapping of invasive species on Catalina Island with collaboration with Catalina Island Conservancy personnel revealed isolated populations of giant on beaches at the southwestern portion of the island. These beaches are about 32 miles from the Santa Ana River estuary. We hypothesized that the populations along mainland beaches and Catalina Island could be the result of mechanical management efforts along the flood control basins such as Santa Ana River that cut the rhizomes into fragments, which then floated down and out into the Pacific ocean. Further, we hypothesized that predominant ocean currents were responsible for pushing these rhizomes back onto mainland beaches or to the Catalina Island beaches. To test this hypothesis, we needed to assess the salt-water tolerance for giant reed rhizomes and then we needed to assess predominant annual ocean currents near the mainland shore and Catalina Island. To test seawater tolerance of giant reed rhizomes we collected hundreds of cut rhizomes to mimic mechanical control with at least 5 nodes. Previous research at Cal Poly revealed that rhizomes with less than 4 nodes were highly variable in their sprouting capacity. Rhizomes were placed into nylon, netted bags, and suspended off the Cal Poly Marine Sciences pier for an extended period of time. Ten rhizomes were removed from the bags at weekly intervals and placed onto beach sand that were contained in small plastic pools. They were irrigated to maintain moisture levels above the base level of 6% volumetric water content. These rhizomes were assessed for mean number of sprouts per 20 cm of rhizome per rhizome. This sequential removal experiment revealed that sprouting ceased after 42 days of exposure to seawater. After 42 days in seawater, many of the rhizomes were colonized by barnacle polyps, which could be an explanation for lost viability in addition to seawater intolerance. We used the ocean current databases from the Coastal Observing Research and Development Center, specifically the Southern California Coastal Ocean Observing System (www.sccoos.org) which compiles high frequency RADAR (HFRADAR) data of ocean currents in real time. From these data we were able to predict the direction and speed at which giant reed rhizomes (or some other floating object) could reach specific beach locations from the Santa Ana River estuary. The maps had a 6 km^2 grid resolution. Typical current velocities were in the range of about 3-15 cm/s (average of 10 cm/s or 0.36 Km/hr thus requiring 17 hours to move from one grid to the adjacent grid roughly 6 km). There appears to be a consistent seasonality to predominant ocean currents and based on direction and speed, March currents tend to explain spread of rhizomes from the Santa Ana River estuary to the beaches south such as Carlsbad but probably not the southwestern Catalina Island beaches. Predominant currents of the Fall could explain the infestation of Catalina originating from the Santa Ana River but this leaves the question

of establishment without rain or other freshwater source. Giant reed rhizomes are certainly capable of landing on a beach in September and waiting for the rains of winter to sprout. Predominant currents of the winter such as in December seemed to consistently move toward the north-west at sufficient directions and velocities, which would send floating objects such as rhizomes into open ocean for a sufficient duration of 42 days preventing giant reed survival. More work needs to be done to better quantify ocean currents for the purpose of making recommendations to vegetation managers of riparian habitat such as the flood control basins of the Santa Ana River and other southern California rivers. However, based on our investigations, any control of giant reed that could allow rhizomes to escape downstream and into open ocean should consider control measures during the early winter months to minimize rhizome survival in open ocean and preventing reestablishment on other mainland and island beaches.