Urochloa mutica

INTRODUCTORY

Photo by Richard Old, XID Services, Inc., Bugwood.org

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FEIS ABBREVIATION:
UROMUT

NRCS PLANT CODE [54]:
URMU

COMMON NAMES:
para grass
buffalo grass
California grass
Carib grass
Scotch grass

TAXONOMY:
The scientific name of para grass is *Urochloa mutica* (Forsk.) T.Q. Nguyen (Poaceae) [29].

SYNONYMS:
Brachiaria mutica [59]
Brachiaria purpurascens [18]

LIFE FORM:
Graminoid

DISTRIBUTION AND OCCURRENCE

SPECIES: Urochloa mutica

GENERAL DISTRIBUTION:
Para grass is native to Africa [18,61]. It is widely cultivated in tropical regions throughout the world for livestock fodder [18,40,56] and erosion control [7,56]. Its distribution is limited to tropical areas due to its sensitivity to frost [25]. Para grass may have been brought to the Americas as bedding in slave ships, arriving in South America by the early 1800s and Mexico by 1872 [40]. It was introduced in Florida by the late 1870s as a fodder plant [32]. Para grass has escaped cultivation in North America [61] and in other parts of its nonnative range [59].

As of this writing (2010) para grass has a limited distribution in northern North America, occurring in South Carolina, Florida, Alabama, Texas, Oregon, Hawaii, and Puerto Rico. It is reported as invasive in Hawaii and Florida [36]. Plants Database provides a distributional map of para grass.

HABITAT TYPES AND PLANT COMMUNITIES:
A weed guide reports that para grass is invasive in riparian habitats, freshwater wetlands, swamps, and disturbed sites [56]. The few North American plant community descriptions available in the literature as of this writing (2010) support this statement. Some of the information presented in this section relies on personal communications between the author and managers in central peninsular Florida [27,48].

Florida: In Florida, para grass occurs in floodplain forests, marshes, swamps, and disturbed areas. It was common in seasonally inundated floodplain forests along the Little Manatee River in south-central Florida. The closed-canopy forest was dominated by laurel oak (*Quercus laurifolia*), sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), cabbage palmetto (*Sabal palmetto*), and sweetbay (*Magnolia virginiana*) [39]. On the southern coastal plain of Florida, para grass occurred with broomsedge bluestem (*Andropogon virginicus* var. *glaucopsis*), lovegrass (*Eragrostis* sp.), and Vasey's grass (*Paspalum urvillei*) in disturbed, wet areas of flatwood forests [58]. In southwestern peninsular Florida, para grass was abundant and often dominant in disturbed floodplain marshes historically dominated by maidencane (*Panicum hemitomum*) and dotted smartweed (*Persicaria punctata*) [26]. In the Lake Okeechobee region of the Florida peninsula, para grass was most often found in emergent marsh communities [48]. In Everglades National Park, Florida, para grass seeds were detected in seed traps (T) and/or in soil seed bank samples (S) in several plant communities including broadleaved, evergreen hammock forests (T); open South Florida slash pine (*Pinus elliottii* var. *densa*) forests (S); seasonally wet prairie glades dominated by gulfhairawn muhly (*Muhlenbergia filipes*), sand cordgrass (*Spartina bakeri*), and sawgrass (*Cladium jamaicense*) (S); nonnative Brazilian pepper (*Schinus terebinthifolius*) forests (S,T); and wax-myrtle (*Myrica cerifera*)-Brazilian pepper woodlands (T) [15]. Herbarium records from Florida documented para grass occurring in floodplain forests; hardwood gallery forests; swamp tupelo-baldcypress (*N. sylvatica* var. *biflora-Taxodium distichum* var. *imbricarium*) swamps; wooded lake margins forested by baldcypress, pond apple (*Annona glabra*) and red maple (*Acer rubrum*); swampy edges of mesic woods; moist hammock edges; the ecotone between a floodplain marsh and swamp; and "pinelands" [60].

Disturbed sites occupied by para grass in Florida include ditch and canal banks [21,48,49,60], fields [21,37,49], and roadsides [37,49,60]. Though most of the referenced disturbed sites were associated with moisture, one source reports para grass establishing in dry areas in a field and along a road [37].

Texas: Herbarium records from Texas documented para grass established over many acres along a river bank. It was also reported as occasional on the mesic berm of a drainage canal. Plant associates included paloverde (*Parkinsonia* sp.), aster (*Aster* sp.), bluestem (*Dichanthium* sp.), sorghum (*Sorghum* sp.), sprangletop (*Leptochloa* sp.), serjania (*Serjania* sp.), and flatsedge (*Cyperus* sp.) [17].

Hawaii: Para grass was one of the most frequently observed plants occurring in both natural and constructed freshwater wetlands on 5 of the Hawaiian Islands [4]. Para grass dominated a freshwater marsh on the island of Oahu [1]. Its establishment in low-elevation riparian areas on the Hawaiian Islands may have contributed to the decline of the rare and endemic Boyd's maiden fern (*Thelypteris boydiae*) [35]. It also occurred in coastal red mangrove (*Rhizophora mangle*) plant communities on Oahu, establishing in riparian areas close to a river mouth [43].

BOTANICAL AND ECOLOGICAL CHARACTERISTICS

SPECIES: Urochloa mutica

GENERAL BOTANICAL CHARACTERISTICS:

Botanical description: This description covers characteristics that may be relevant to fire ecology and is not meant for identification. Keys for identification are available (e.g., [18,61,62]).

Para grass is a perennial stoloniferous grass [14,32]. Stems may reach 3 feet (1 m) when erect or 15 feet (3 m) when creeping. Inflorescences are terminal panicles up to 8 inches (20 cm) long, with 8 to 20 ascending, alternate branches. Spikelets are dense, paired, and approximately 3 mm long [32].

Para grass stolons.
Photo by Richard Old, XID Services, Inc., Bugwood.org

Raunkiaer [42] **life form:**
Hemicryptophyte

SEASONAL DEVELOPMENT:
Para grass flowers in autumn in central Florida [61] and Texas [17].

REGENERATION PROCESSES:

- **Vegetative regeneration**
- **Pollination and breeding system**
- **Seed production**
- **Seed dispersal**
- **Seed banking**
- **Germination**
- **Seedling establishment**

Some of the information presented in this section relies on personal communications between the author and managers in central peninsular Florida [27,48].

The primary means of para grass reproduction is vegetative spread via stolons [25,32,48,56]. Reproduction by seed is uncommon [20,25,32,40,48,56].

Vegetative regeneration: Three weed guides [25,32,56] and 2 managers from Florida [27,48] report that para grass reproduces and spreads primarily through vegetative means. Because most spread occurs via creeping stolons, one weed guide suggested that para grass establishment and spread are limited to areas adjacent to where it is either already established or has been planted [25]. Para grass was reported spreading into crop fields from adjacent small streams and irrigation ditches [25]. Spread may also occur along watercourses through the transport of stolons downstream, though such spread has not been specifically documented in the literature.

Para grass sprouts following top-kill from burning [27,48], disking, and herbicide treatments. Managers in Florida report it sprouting as soon as 10 days [27] to 2 weeks [48] following top-kill.

Once established, para grass forms dense monocultures [22,27,48]. A weed guide reports that para grass exhibits rapid growth and high productivity [32]. In Florida, para grass established in small patches, but within patches it accounted for 75% to 100% of the vegetative cover [27]. In seasonally inundated wetlands in northern Australia, para grass monocultures covered many thousands of acres, representing 75% to 95% of the vegetative cover [16].

Para grass may form a floating mat of vegetation where it occurs near water [56,59]. A weed guide reports that para grass mats may reach >3 feet (1 m) in depth [25,56] and floating stolons may grow >20 feet (6 m) in length in slowly moving water [56]. Herbarium records from Florida documented floating stems >7 feet (2 m) long [60].

Pollination and breeding system: No information is available on this topic.

Seed production: Three weed guides [25,32,56] and one manager in Florida [48] report that para grass produces few fertile seeds.

Seed dispersal: No information is available on this topic.

Seed banking: As of this writing (2010) little information is available regarding seed banking of para grass. In Brazil, para grass germinated from the soil seed bank of a 40-year-old forest fragment. Para grass seedlings emerged at a low density (0.14%) and frequency (0.54%) relative to other plant species [34]. In Everglades National Park, para grass seeds germinated from soil samples collected 3 weeks after a November prescribed fire at a density of 3.8 seedlings/m² [15] (see Fire adaptations and plant response to fire for more information on this study).

Germination: As of this writing (2010) there is little published information on the germination requirements of para grass seeds. A manager in Florida observed that para grass seeds did not seem "to be very viable" [48]. Laboratory germination tests showed that under ambient temperatures and natural lighting, para grass seed was capable of germination in both still and aerated water (16% and 24 % germination rates, respectively) [10].

Seedling establishment: It is not clear what conditions are conducive to para grass seedling establishment, as accounts of para grass establishing via seed are sparse in the literature. In Brazil, seedlings emerged from the soil seed bank in forest fragments disturbed by grazing [34].

SITE CHARACTERISTICS:
Para grass establishes in wet [16,17,18,48,56,59,62] and/or disturbed areas [16,26,48,56,58,62]. Weed guides and floras report para grass in riparian habitats, freshwater wetlands, and swamps, and on disturbed sites such as canal or ditch banks [17,21,32,49,56] and irrigated croplands [21]. See Habitat types and plant communities for descriptions of plant communities where para grass occurs in North America.

Moisture: Para grass establishes most often on moist sites. A weed guide reports that para grass establishes primarily in wet areas but can adapt to a wide range of moisture conditions [25]. One manager in Florida observed that para grass was capable of growing in disturbed xeric sites, but it did not "thrive" there. It was more common in mesic areas along ditches and the edges of lakes, creeks, and rivers [27]. In planted para grass stands in India, aboveground biomass was lower in open areas with low soil moisture compared to shaded areas with high soil moisture [44].

Para grass tolerates partial or total water inundation [14,16,20,25,39] and is valued as a fodder plant for its ability to grow "luxuriantly" in swampy, nearly waterlogged conditions. It grows well in brackish water [25].

Soils: Soil characteristics favored by para grass are unknown. Herbarium records from Florida report para grass occurring on moist sand or "mucky" soil [60]. Botanical surveys in Florida documented para grass occurring in a dry, sandy soil [37]. Herbarium records from Texas report it occurring on brown clay, fine clay, clay, clay loam, and silt [17]. One manager in Florida reported that para grass prefers disturbed sites with organic soil [48]. In India, para grass was planted on a silt loam with pH 9.1 [44].

Climate: Para grass occurs in tropical climates and its distribution is limited by its susceptibility to frost [25]. Its range may extend into subtropical climates in some areas [22]. Weed guides report that it tolerates prolonged drought [25,56].

SUCCESSIONAL STATUS:
Para grass seems adaptable to a range of successional stages. Its dependence on vegetative spread for reproduction and its association with moisture suggest that moisture and the presence of existing para grass populations may be more important determinants of establishment and spread than community successional status.

Several sources report para grass establishing in disturbed areas [16,26,48,56,58,62] and one manager in Florida reported that disturbed sites seemed to be favored for establishment [48]. In northern Australia, para grass established in seasonally inundated wetlands where wild boar wallowing created patches of bare ground [16]. Para grass populations have also expanded following herbicide applications to cropping systems [38] or adjacent stands of para grass [49] (See Chemical control).

Para grass also occurs in the understory of several forested plant communities in Florida [39,60] (see Habitat types and plant communities), and one weed guide reports that it has some level of shade tolerance, making it problematic in tree and field plantation crops [25]. It appears to be favored by high-light conditions, as shading treatments were used to reduce para grass biomass in and around open-canopy stream channels in Australia [7] (see Physical or mechanical control).

Para grass may alter successional pathways in the plant communities where it occurs. The tendency of para grass to form dense monocultures may lead to the displacement of native vegetation [16,32,48,56], potentially disrupting successional pathways. See Impacts for more information on this topic.

FIRE EFFECTS AND MANAGEMENT

SPECIES: Urochloa mutica

- FIRE EFFECTS
- FUELS AND FIRE REGIMES
- FIRE MANAGEMENT CONSIDERATIONS

FIRE EFFECTS:
Much of the information presented in this section relies on personal communications between the author managers in central peninsular Florida [27,48].

Immediate fire effect on plant: High-severity fires that burn down to mineral soil may kill para grass. Low-severity fires may top-kill para grass [48] but sprouting may occur within 1 to 2 weeks [27,48]. As of this writing (2010) there was little information available on fire effects on para grass seeds. One study suggests that para grass seeds may survive fire. Para grass seeds germinated from soil samples collected 3 weeks after a November prescribed fire in Everglades National Park [15] (see Fire adaptations and plant response to fire for more information on this study).

Postfire regeneration strategy [50]:
Tussock graminoid
Ground residual colonizer (on site, initial community)

Fire adaptations and plant response to fire: Para grass appears to posses some traits (e.g., sprouting after top-kill, rapid growth rate) that allow it to survive and persist after fire under certain conditions.

In the Lake Okeechobee region of Florida, one manager observed para grass mortality following high-severity wildfire. After lower-severity wildfire, para grass was generally top-killed but sprouted within 2 weeks [48]. After high-severity prescribed fire at the Archbold Biological Station, Florida, para grass cover was immediately reduced by >95%, but sprouting occurred within 6 to 7 days of the treatment. The manager thought it likely that para grass cover returned to prefire levels within 3 to 6 months [27]. Para grass cover showed no change after 5 years of annual, high-severity prescribed fire in Everglades National Park [13]. See Use of prescribed fire as a control agent for more information on fire characteristics of these studies.

Para grass sprouting 2 weeks after prescribed fire.
Photo by Jeff Hutchinson, University of Florida

The results of a study from Everglades National Park suggest that para grass seeds may survive fire, though it is not clear whether fire improves germination or if seeds germinate under field conditions. Para grass seedlings emerged at a density of 3.8 seedlings/m² from soil samples (1 to 2 inches (2-6 cm) in depth) collected 3 weeks after a November prescribed fire. Seedlings did not emerge from soil samples taken just prior to the fire. However, sampling effort was much greater after the fire (4 prefire samples versus 20 postfire samples), making it difficult to determine whether these results were due to fire creating conditions conducive to germination or to the increased sampling effort [15].

FUELS AND FIRE REGIMES:

- **Fuels**
- **Fire regimes**

Fuels: Para grass has the potential to alter local fuel characteristics, though it is likely that this potential varies with the characteristics of the local plant community.

Managers in Everglades National Park examining the impact of repeated spring prescribed fire on Brazilian pepper conducted their experiments in areas where para grass was established, as these were the only areas that had sufficient fine fuels to carry fire. At the time of fire, para grass dominated fine fuels, with >75% cover in some areas. Fine fuels were 50% to 60% live, a higher proportion of live fuels than that occurring in local native plant communities [12,13]. Enough fine fuels accumulated annually that, with a few exceptions, prescribed fires could be conducted every year in 5 different areas [13].

A manager from the Lake Okeechobee region of Florida reported that para grass establishment has altered local fuel characteristics. He observed that para grass establishment in freshwater marshes increased standing biomass and fuel loading, which in turn increased fire severity, particularly in times of drought. In some areas, para grass establishment facilitated peat fires that resulted in

uncharacteristically high cypress (*Taxodium* spp.) mortality [48].

Para grass establishment in a freshwater marsh, leading to increased standing biomass and fuel loading.
Photo by Jeff Hutchinson, University of Florida.

Another manager from the Archbold Biological Station, Florida, reported that para grass and the flatwood scrub community it replaced both "burn intensely with a head fire" [27], making it difficult to say that para grass altered local fuel characteristics.

Fire regimes: It is not clear what fire regime para grass is best adapted to. Fire severity may impact para grass survival, though observations and 1 study from Florida are not consistent.

In the Lake Okeechobee region, para grass was able to survive and sprout following low-severity prescribed fire, but para grass was killed by high-severity wildfire that burned down to mineral soil [48]. Para grass survived and sprouted following a high-severity prescribed fire near the Archbold Biological Station [27] and maintained its presence through 5 years of annual, high-severity prescribed fires in Everglades National Park, with no detectable change in cover over time [13]. See Use of prescribed fire as a control agent for more information on this topic.

Lake Okeechobee wildfire.
Photo by Chuck Hanlon, South Florida Water Management District

The alteration of local fuel characteristics following para grass establishment may alter historical fire regimes. A manager in Florida reported that the increase in standing biomass and fuel loading in areas with para grass increased fire severity, resulting in uncharacteristically high cypress mortality [48]. As of this writing (2010) no information is available regarding the impact of para grass on fire frequency. See the Fire Regime Table for information on fire regimes of vegetation communities in which para grass may occur.

FIRE MANAGEMENT CONSIDERATIONS:

Potential for postfire establishment and spread: Because most para grass reproduction occurs through vegetative spread and seed production is rare (see Regeneration processes), it is unlikely that para grass would establish in or spread into burned areas unless an existing population was in close proximity. A manager in Florida did not observe para grass spreading into burned areas when it was established nearby. Its spread was described as "slow" in both unburned and burned areas where it sprouted following prescribed fire [27]. Managers in Everglades National Park saw no evidence to suggest that 5 years of annual prescribed fires promoted the establishment and/or spread of para grass in the study area [13].

Preventing postfire establishment and spread: Burned areas with established para grass populations onsite or nearby should be monitored to assess the likelihood of postfire establishment and spread. Though one manager did not observe para grass spreading into burned areas following a prescribed fire in Florida [27], para grass has spread into areas treated with herbicides [49].

Preventing invasive plants from establishing in weed-free burned areas is the most effective and least costly management method. This may be accomplished through early detection and eradication, careful monitoring and follow-up, and limiting dispersal of invasive plant propagules into burned areas. General recommendations for preventing postfire establishment and spread of invasive plants include:

- Incorporate cost of weed prevention and management into fire rehabilitation plans
- Acquire restoration funding
- Include weed prevention education in fire training
- Minimize soil disturbance and vegetation removal during fire suppression and rehabilitation activities
- Minimize the use of retardants that may alter soil nutrient availability, such as those containing nitrogen and phosphorus
- Avoid areas dominated by high priority invasive plants when locating firelines, monitoring camps, staging areas, and helibases
- Clean equipment and vehicles prior to entering burned areas
- Regulate or prevent human and livestock entry into burned areas until desirable site vegetation has recovered sufficiently to resist invasion by undesirable vegetation
- Monitor burned areas and areas of significant disturbance or traffic from management activity
- Detect weeds early and eradicate before vegetative spread and/or seed dispersal
- Eradicate small patches and contain or control large infestations within or adjacent to the burned area
- Reestablish vegetation on bare ground as soon as possible
- Avoid use of fertilizers in postfire rehabilitation and restoration
- Use only certified weed-free seed mixes when revegetation is necessary

For more detailed information on these topics, see the following publications: [2,5,19,53].

Use of prescribed fire as a control agent: There is little evidence to suggest that prescribed fire is a useful tool for controlling para grass. There is also little evidence to suggest that prescribed fire encourages further para grass establishment or spread.

Prescribed fires have been conducted in Florida in areas with para grass, though it was not the specific target of fire treatments. A manager from the Lake Okeechobee region provided the following information on wildfire and prescribed fire characteristics in areas with para grass. Cattails (*Typha* spp.), torpedo grass (*Panicum repens*), and mixed herbaceous species are the primary fuels [48].

Typical wildfire and prescribed fire conditions in the Lake Okeechobee region of Florida [48]		
	Wildfire	Prescribed fire
Surface wind characteristics	WNW; 10-25 mph	SSE; 10-15 mph
Minimum mixing depth (feet)	1,500-2,000	2,000-2,500
Atmospheric dispersion	Poor to fair	Generally good

Relative humidity (%)	10-40	50-60
Maximum temperature (°F)	75	85
Minimum temperature (°F)	32	70
Fine fuel moisture (%)	5-15	40-50
Rate of spread (feet/hour)	5,280-13,200	2,640-3,960
Flame length (feet)	15-40	15-30

Wildfires in the region typically occur in the winter months (January through March) under extreme drought conditions. Wildfires are usually head, flank and backing fires, but managers use aerial strip head fires in burnout operations. In some cases, wildfire is of high severity, burning down to mineral soil. Under such conditions, para grass mortality has occurred.

Most prescribed fires in this region are conducted in the fall when lake levels begin to decline. Prescribed fires are usually aerial strip head fires conducted on units of 3,000 to 5,000 acres (1,200- 2,000 ha). Prescribed fires are generally of lower severity than wildfires and are conducted mainly as an integrated tool for controlling torpedo grass and reducing fuels. Para grass is generally top-killed following prescribed fire but may sprout within 2 weeks of treatment [48]. Though para grass has been killed by high-severity wildfires in extreme drought conditions, conducting prescribed fires under such conditions may not be advisable.

A manager from the Archbold Biological Station reported the response of para grass to a January prescribed fire. The 124,000-acre (50,000-ha) head fire was of high severity, with nearly 100% scorch, rapid movement, and 10- to 13-foot (3-4-m) flame lengths. Fire reduced the cover of para grass by more than 95%, but sprouting occurred within 6 to 7 days. The manager thought it likely that para grass cover returned to prefire levels within 3 to 6 months. Para grass did not appear to spread into burned areas when it was established nearby. Its spread was described as "slow" in both unburned and burned areas where it sprouted following prescribed fire [27].

Managers in Everglades National Park examining the impact of repeated spring prescribed fire on Brazilian pepper in abandoned agricultural land conducted their experiments in areas where para grass was established, as these were the only areas that had sufficient fine fuels to carry fire. Para grass dominated fine fuels, with >75% cover in some areas (See Fuels). Because head fires consistently left 25% to 30% of the fine fuels unburned, backing fires were used and all fine fuels were consumed [12,13]. Over 5 years of annual spring burning, para grass cover varied within and between transects and showed no clear trend relative to fire. Para grass cover increased on one burned transect, but the authors observed that this transect was wetter than the others and suggested that para grass cover was related more to hydrological conditions than fire treatment. The authors concluded that repeated burning did not promote the establishment and/or spread of para grass in the study area [13].

A manager in Florida suggested that a combination of prescribed fire and herbicide application may control para grass more effectively than either treatment alone. Though this technique had not been tested on para grass as of this writing (2010), herbicides have been applied after prescribed fire to control torpedo grass in the region. Fire breaks the apical bud of torpedo grass, increasing herbicide efficacy [48]. Applying herbicide prior to prescribed burning may be less effective. A manager from the Archbold Biological Station, Florida, reported that on disturbed xeric sites, treatment with glyphosate followed by prescribed fire did not reduce the cover of para grass and other nonnative plant species. Fire seemed to stimulate para grass sprouting, and the site was dominated by ruderal species within 6 months of treatment [27].

Altered fuel characteristics: It is possible that fuel characteristics in areas with para grass may diverge from historical conditions. Managers in Everglades National Park used prescribed fires in certain areas specifically because of the increased fuel loading provided by para grass, which differed from that in native plant communities and other areas without para grass [12,13]. A manager in Florida reported that para grass establishment in freshwater marshes increased standing biomass and fuel loading, which in turn increased fire severity, particularly in times of drought [48]. However, another manager in Florida reported that para grass burns "intensely with a head fire", as did the flatwood scrub community it replaced [27]. These observations make it difficult to conclude that para grass altered local fuel characteristics. See Fuels for more information on this topic.

MANAGEMENT CONSIDERATIONS

SPECIES: Urochloa mutica

- FEDERAL LEGAL STATUS
- OTHER STATUS
- IMPORTANCE TO WILDLIFE AND LIVESTOCK
- OTHER USES
- IMPACTS AND CONTROL

FEDERAL LEGAL STATUS:
None

OTHER STATUS:
Information on state-level noxious weed status of plants in the United States is available at Plants Database.

IMPORTANCE TO WILDLIFE AND LIVESTOCK:
Palatability and nutritional value: Para grass is widely cultivated in tropical regions throughout the world for its value as livestock fodder [18,40,56,59]. Its consumption by livestock supports milk production in some areas [40]. However, para grass grown in high-nutrient conditions may accumulate enough nitrates and oxalates in its foliage to be toxic to livestock [41], including domestic rabbits [47].

In Hawaii, leaves of para grass plants <4 inches (10 cm) long were eaten by the federally endangered Hawaiian moorhen. Despite para grass consumption, managers did not encourage it as a forage plant because it had other negative impacts on the habitat quality of local wetlands [11].

Cover value: No information is available on this topic.

OTHER USES:
Para grass has been planted for erosion control [7,56] and has been used to phytoremediate domestic sewage [22]. In southeastern Florida, para grass was used as camouflage around military installations during World War II [45].

IMPACTS AND CONTROL:
Some of the information presented in this section relies on personal communications between the author and managers in central peninsular Florida [27,48].

Impacts: The tendency of para grass to form dense monocultures may lead to the displacement of native vegetation [16,32,48,56]. A weed guide reports that it exhibits rapid growth and high productivity, and may possess allelopathic qualities [32]. One manager in Florida reported that it established in disturbed areas near Lake Okeechobee and then spread into native plant communities, forming a dense monoculture [48]. A weed guide reports that para grass displaces native vegetation along river and lake shorelines and in marshes and swamps in Florida [32]. Another weed guide reports that para grass may overtop and limit the growth of shrubs and young trees [56]. In seasonally inundated wetlands in northern Australia, para grass comprised 75% to 95% of the vegetative cover in some areas. The mean number of plant taxa was reduced by 50% when para grass was present [16]. In low-elevation riparian areas of Hawaii, the establishment of para grass and other nonnative species was suspected in the decline of the rare and endemic Boyd's maiden fern [35].

Para grass establishment may impact the wildlife habitat quality of areas where it establishes. In seasonally inundated wetlands in northern Australia, bird abundance and diversity were relatively low in areas with para grass compared to areas without it. Few bird species showed a preference for habitats with para grass; most bird species were associated with areas of native vegetation or other habitats lacking para grass [16]. However, macroinvertebrate communities in a seasonally-flooded tropical floodplain in northern Australia were not altered by para grass presence. The authors suggested that the lack of macroinvertebrate community response was related to the similarity in physical structure of para grass to the native grasses it replaced [14].

Para grass may be disruptive to human activities. It is reported as an agricultural pest in 23 crops in 34 countries, including the United States [25]. In Australia, high levels of sediment accumulated in riparian areas with para grass, leading to changes in stream morphology and hydrology [7]. In the Everglades region of Florida, para grass establishment along irrigation ditches led to extensive trapping of debris and a consequent reduction in water flow [49]. It may also impede water flow and traffic on small streams and canals [25].

Control: Control of para grass is complicated by the ability of plants to sprout following top-kill. Repeated treatments may be necessary to control para grass [27].

In all cases where invasive species are targeted for control, no matter what method is employed, the potential for other invasive species to fill their void must be considered [6]. Control of biotic invasions is most effective when it employs a long-term, ecosystem-wide strategy rather than a tactical approach focused on battling individual invaders [33].

Fire: For information on the use of prescribed fire to control this species, see Fire Management Considerations.

Prevention: It is commonly argued that the most cost-efficient and effective method of managing invasive species is to prevent their establishment and spread by maintaining "healthy" natural communities [33,46] (e.g., avoid road building in wildlands [52]) and by monitoring several times each year [28]. Managing to maintain the integrity of the native plant community and mitigate the factors enhancing ecosystem invasibility is likely to be more effective than managing solely to control the invader [24].

Weed prevention and control can be incorporated into many types of management plans, including those for logging and site preparation, grazing allotments, recreation management, research projects, road building and maintenance, and fire management [53]. See the Guide to noxious weed prevention practices [53] for specific guidelines in preventing the spread of weed seeds and propagules under different management conditions.

Cultural control: No information is available on this topic.

Physical or mechanical control: A manager in the Lake Okeechobee region of Florida reported that small populations of para grass may be controlled with repeated disking [48]. A manager from the Archbold Biological Station, Florida noted that disking resulted in a reduction in para grass cover, but plants sprouted following treatment [27]. A weed guide suggests that small populations may be controlled manually or with mechanical harvesters [56]. In field experiments in Australia, shading (50% and 90% shade) for 3 months reduced the height and standing biomass of para grass compared to plots with no shade ($P<0.0001$). Treatments of 90% shade resulted in a 63% mean reduction in height and a 52% mean reduction in total biomass [7]. A weed guide reports that para grass does not tolerate continued grazing and trampling by livestock [25].

One source reports that using mechanical methods to control para grass is costly and not effective in the long term [49].

Biological control: As of this writing (2010), no information is available regarding the use of biological control agents to control para grass. Biological control of invasive species has a long history that indicates many factors must be considered before using biological controls. Refer to these sources: [55,57] and the Weed control methods handbook [51] for background information and important considerations for developing and implementing biological control programs.

Chemical control: Herbicides are effective in gaining initial control of a new invasion or a severe infestation, but they are rarely a complete or long-term solution to weed management [8]. See the Weed control methods handbook [51] for considerations on the use of herbicides in natural areas and detailed information on specific chemicals.

Herbicides may be effective in controlling para grass [48,49,56], though its presence in aquatic areas may present challenges to chemical control programs. One source reports that para grass may be resistant to some herbicides or herbicides may take as long as 3 months to kill root systems [38]. A manager in Florida observed that herbicide treatments temporarily reduced the cover of para grass, but sprouting occurred following treatments. Glyphosate application was more effective at controlling para grass than burning and disking, but herbicide treatments had to be repeated [27].

If para grass occurs adjacent to areas treated with herbicides, it may spread into treated areas if it is not monitored and controlled [49]. Herbicide use in some cropping systems has led to an increase in para grass density because it replaced other plants that were more susceptible to chemical treatment [38]. For recommendations on chemical control of para grass, see [49].

Integrated management: See Use of prescribed fire as a control agent for examples of treatments integrating prescribed fire and herbicide application to control para grass.

APPENDIX: FIRE REGIME TABLE

SPECIES: Urochloa mutica

The following table provides fire regime information that may be relevant to para grass habitats. Follow the links in the table to documents that provide more detailed information on these fire regimes.

Fire regime information on vegetation communities in which para grass may occur. This information is taken from the LANDFIRE Rapid Assessment Vegetation Models [31], which were developed by local experts using available literature, local data, and/or expert opinion. This table summarizes fire regime characteristics for each plant community listed. The PDF file linked from each plant community name describes the model and synthesizes the knowledge available on vegetation composition, structure, and dynamics in that community. Cells are blank where information is not available in the Rapid Assessment Vegetation Model.

South-central US   Southeast

South-central US

Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
South-central US Forested					
Southern floodplain	Replacement	42%	140		
	Surface or low	58%	100		
Southern floodplain (rare fire)	Replacement	42%	≥1,000		
	Surface or low	58%	714		

Southeast

- Southeast Grassland
- Southeast Woodland
- Southeast Forested

Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
Southeast Grassland					
Everglades sawgrass	Replacement	96%	3	2	15
	Surface or low	4%	70		
Floodplain marsh	Replacement	100%	4	3	30
Everglades (marl prairie)	Replacement	45%	16	10	20
	Mixed	55%	13	10	
Southeast Woodland					
South Florida slash pine flatwoods	Replacement	6%	50	50	90
	Surface or low	94%	3	1	6
Southeast Forested					
Maritime forest	Replacement	18%	40		500
	Mixed	2%	310	100	500
	Surface or low	80%	9	3	50
Mesic-dry flatwoods	Replacement	3%	65	5	150
	Surface or low	97%	2	1	8
Southern floodplain	Replacement	7%	900		
	Surface or low	93%	63		

*Fire Severities—
Replacement: Any fire that causes greater than 75% top removal of a vegetation-fuel type, resulting in general replacement of existing vegetation; may or may not cause a lethal effect on the plants.
Mixed: Any fire burning more than 5% of an area that does not qualify as a replacement, surface, or low-severity fire; includes mosaic and other fires that are intermediate in effects.
Surface or low: Any fire that causes less than 25% upper layer replacement and/or removal in a vegetation-fuel class but burns 5% or more of the area [23,30].

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