

Appendix F. Tidewater Goby Survey Protocol

1. Introduction

The tidewater goby (*Eucyclogobius newberryi*), a species of fish endemic to California, has undergone substantial reduction in population size and distribution within its range in recent years. Surveys for the species have been conducted using a variety of methods over the past 2 to 4 decades. We, the U.S. Fish and Wildlife Service, seek to increase the scientific information available upon which to base future management and conservation of the species, including efforts for recovery. Through the survey protocol recommended in this document, we intend to promote survey methods and intensities that ensure sound and supportable presence/absence determinations of species locations, leading to better management decisions based on the best available scientific data.

We provide the following guidance to facilitate the determination of presence or absence of the species in habitats with potential to support it. We anticipate that the primary use for this protocol will be for project-level surveys in support of requests for consultation under section 7 of the Endangered Species Act of 1973, as amended. Additionally, this protocol may also be used for section 10(a)(1)(B) permit applications, and to determine general presence-absence for other management purposes.

In general, surveys for wildlife and fish species may be done to meet a variety of management objectives, including but not limited to: 1) confirming the presence or absence of a species at a particular location, 2) identifying habitats potentially occupied, 3) estimating population size, and 4) determining population trends. For the purposes of this protocol, we have focused primarily on the first objective, determining presence/absence of a species at particular sites. The protocol is also likely to provide supporting information in identifying locations and habitat types currently occupied by the species. It is not the intent of this protocol to estimate population size or determine population trends.

Section 9 of the Endangered Species Act of 1973, as amended, and Federal regulations pursuant to Section 4(d) prohibit the take¹ of endangered and threatened species fish and wildlife species without special exemption. Virtually all methods to survey for gobies require the surveyor to enter the species' habitat,

1 **Take** is defined by the Act as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct.” [ESA §3(19)] **Harm** is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. **Harass** is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. [50 CFR §17.3]

resulting in an unavoidable risk of take of the species should it occur there. Therefore, a final objective of this survey protocol is to minimize the incidental take of gobies by implementing survey methods and intensities that are likely to minimize the take of gobies through the survey methodology itself.

2. Background

Habitat Affinity

The tidewater goby inhabits primarily waters of coastal lagoons, estuaries, and marshes. The species is benthic in nature as an adult (Swift 1980). Its habitat is characterized by brackish shallow lagoons and lower stream reaches where the water is fairly still, but not stagnant (Miller and Lea 1972; Moyle 2002; Swift *et al.* 1989; Wang 1982; Irwin and Soltz 1984). Tidewater gobies exhibit a preference for a sand substrate component for breeding, but they are also found on rocky, mud, and silt substrates as well. Tidewater gobies have been documented in waters with salinity levels from 0 to 42 parts per thousand, temperature levels from 8 to 25 degrees Celsius (46 to 77 degrees Fahrenheit), and water depths from 25 to 200 centimeters (10 to 79 inches) (Irwin and Soltz 1984; Swift *et al.* 1989; Worcester 1992; Lafferty 1997; Smith 1998).

In their study, Trihey and Associates (1996) report tidewater gobies concentrated within 30 meters of the shore and in waters between 0.5 and 1.0 meter deep. In addition, higher densities of tidewater gobies were found in areas containing submerged aquatic vegetation than those containing only emergent vegetation or no vegetation.

Tidewater gobies have been reported from estuaries in California ranging from Tillas Slough at the mouth of the Smith River (northern Del Norte County) to Agua Hedionda Lagoon (northern San Diego County). The distribution of the tidewater goby corresponds to the distribution of sand deposition within the littoral cells along the California coast (Capelli 1997). Apparently, none have ever been found in Mexico or Oregon, based on extensive surveys outside of California.

The tidewater goby appears to spend all life stages in lagoons, in tidally influenced portions of coastal waters, or in freshwater habitats adjacent to these water bodies. Tidewater gobies may enter marine environments when flushed out of the estuary/lagoon by breaching of the sandbars following storm events or human manipulation. The tidewater goby generally lives to about 1 year of age, although some variation has been observed (Swift *et al.* 1989; Wang 1982; Irwin and Soltz 1984). During this single year, it is able to complete its life cycle.

Reproduction occurs year-round, although a distinct peak in spawning occurs in April and May (Moyle *et al.* 1989). Detailed information regarding the biology of the tidewater goby can be found in Wang (1982), Irwin and Soltz (1984), Swift *et*

al. (1989), Worcester (1992), Swenson (1995), Lafferty *et al.* (1999), and Swenson (1999).

Swenson (1995) reported that field studies of tidewater gobies in central California revealed different patterns in population ecology among different habitats. Feeding ecology differed for gobies in lagoon, creek and marsh habitats. Tidewater gobies in the marsh were significantly larger, more fecund and potentially longer-lived than tidewater gobies in the lagoon or creek. However, sandy lagoons may be more important than muddy marshes as spawning habitat because males in lab studies preferred to dig spawning burrows in sand rather than mud. Although lagoons are considered the typical habitat of tidewater gobies, brackish marshes can also be important, perhaps due to better food resources or reduced disturbance regimes. Marshes may serve as refugia, providing a source population for recolonization of the creek and lagoon habitats after high-flow events.

Developing monitoring programs to assess abundance patterns can be difficult because tidewater gobies can be patchily distributed within habitats.

2.1 Legal Status

On March 7, 1994, we listed the tidewater goby as endangered throughout its range under the Act (U.S. Fish and Wildlife Service 1994). We designated critical habitat on November 20, 2000, for the southern California populations (U.S. Fish and Wildlife Service 2000). On June 24, 1999, we published a proposed rule to remove the northern populations of the tidewater goby from the endangered species list (U.S. Fish and Wildlife Service 1999). The proposed rule to delist was withdrawn on November 7, 2002 (U.S. Fish and Wildlife Service 2002), following significant public and species expert comments. Therefore, the current status of the species remains listed as endangered throughout its range, and critical habitat remains as designated in 2000. A recovery plan is in development.

The tidewater goby was listed as a species of special concern by the California Department of Fish and Game in 1980, and was elevated to fully protected status in 1987 (Swift *et al.* 1997).

2.3 Methods Applied to Prior Surveys

This section provides a brief summary of survey methods used in the past, their success, and the recommendations for improvement by those who used them. This information is provided to assist the reader in understanding the effectiveness of those methods, and the relative efficiency of each. In addition, this information assists the reader in understanding why we recommend the methods in the protocol, described later in this document, rather than other methods that to the uninitiated might seem better or more cost effective. We

believe that this information adequately supports our proposed protocol, thus promoting consistency among all surveyors. However, any and all methods proposed to conduct surveys for tidewater goby should receive our consideration, as appropriate.

Tidewater goby abundance and distribution can be affected by habitat characteristics such as vegetation, substrate and depth (Swift *et al.* 1989, Worcester 1992, Swenson 1995). These factors can also influence the efficiency of sampling methods. Tidewater gobies have been successfully collected with both seines (Swift *et al.* 1989, Swenson 1995) and meter-square throw traps (Worcester 1992, Swenson 1995). Other reported methods include dip nets, minnow traps, ichthyoplankton net, snorkeling/direct observation, and plastic tubes. Each is described in more detail below.

2.3.1 Seine Netting

Seine netting is one of the most common methods utilized in tidewater goby surveys (Wang 1984; Holland 1992; Swift 1994; Swenson 1994; Swenson 1996a, 1996b; Lafferty *et al.* 1997; Fong 1997; Swift 1997) throughout the species range. The technique can be applied over a variety of habitats, but does have limitations in areas with dense emergent vegetation (Trihey and Associates 1996). Seining is a commonly used collecting method, well suited for near-shore areas with smooth bottoms and little vegetation.

Seine nets used for goby surveys ranged in length from as short as 1.2 meter (Wang 1984; Swenson 1996b; Swift 1997; Wang and Keegan 1998) to 7.3 meter (Swenson 1994; Swenson 1995). Other commonly used lengths include 1.8 meter (Holland 1992; Swift 1997), 2.1 meters (Swenson *et al.* 1996a), 3 meters (Lafferty *et al.* 1997; Wang 1984), and 5 meters (Swift 1997). The nets ranged in height from 1.0 meter to 1.8 meter. Equivalent ¼ inch mesh seine nets sold in the U.S. range sizes from 6 feet by 4 feet, 10 feet by 4 feet, 6 feet by 10 feet, and 6 feet by seventeen feet.

Various mesh sizes have been used. Reported mesh sizes ranged from 0.5 millimeter to greater than 6 millimeters. Commonly used mesh sizes included those near 3 millimeters [1/4 inch](Wang 1982; Wang 1984; Fong 1997, Lafferty *et al.* 1997; Swift 1997; Wang and Keegan 1998), 4 millimeters (Swenson 1995; Swenson 1996b), 3.1 millimeters (Swift *et al.* 1994), 4.8 millimeters (Fong 1997), and greater than 6 millimeters (Holland 1992; Trihey and Associates 1996; Fong 1997). Due to their small size, especially when in the larval or subadult form, tidewater gobies can easily escape from the seine if the mesh size is too large. Fong (1997) selected a 3.1-millimeter delta mesh because gobies were observed squeezing through the 6.4-millimeter mesh and 4.8-millimeter mesh.

Swift (1997) used 28.5-gram (1-ounce) weights centered 15.2 centimeters (6 inches) apart on the lead line, to ensure the bottom of the seine remain in close contact with the subsurface, preventing gobies from escaping.

Wang (1982, 1984) used 1.2 x 1.0 meter beach seine with 1.0 millimeter mesh to larvae, and juveniles in the inshore zones with vegetation. Wang and Keegan (1998) collected specimens with a beach seine with 500 micron (0.5 millimeter) mesh to sample juvenile and adult tidewater goby and other fish species.

Swenson (1994) used a seine (7.3 meters x 1.2 meter, 4 millimeter-square mesh) in shallow water (5 to 80 centimeters deep) to sample adults and juveniles. Swenson (1995) sampled in water 20 to 120 centimeters deep to capture adults and juveniles.

The distance of each seine haul varied with researcher and application. Holland (1992) used a minimum of three stations to be sampled within the available aquatic habitat. Each station consisted of five sweeps, each sweep was 10 meters in length, and all sweeps were 2 to 3 meters apart. Wang and Keegan (1998) hauled their seines from 3 to 10 meters along the shoreline, depending on the size of the station. Trihey and Associates (1996) hauled the seine perpendicular to the shoreline and landed the net on shore, where possible. Swenson (1995) reported a total linear distance sampled as approximately 150 meters, but did not report the length of each haul. Trihey and Associates (1996) recommended shortening the seine's width to approximately 3 meters to reduce total catch and time for net clearing and to minimize stress to captured fish.

2.3.2 Drop or Throw Traps

Drop or throw trapping is an effective method for sampling small fishes in vegetated areas or in open water sites that are difficult to seine (Kushlan 1981; Rozas and Odum 1988; Chick *et al.* 1992; Swenson 1996a). Tidewater gobies have been successfully collected with meter-square throw traps (Worcester 1992, Swenson 1995).

Trihey and Associates (1996) sampled with throw trap consisting of two 1 meter square plastic frames (polyvinyl chloride pipe, 1.27 centimeter diameter) connected with net sides (1.6 millimeter Delta mesh) (Worcester 1992). The lower frame is weighted with water and metal reinforcing bars, and a skirt of netting enclosing a chain is attached to the lower frame to seal the bottom over uneven substrate. Swenson (1995) constructed the drop net with one frame's corners closed to trap air (the floating top frame) and the other frame's comers left open to fill with water when in use (the heavy bottom frame). These frames were attached to the top and bottom edges of 1.2 meter wide fine netting (1.6 millimeter Delta mesh) to form a square tube.

Setting the drop trap is a two-person task. The two polyvinyl chloride pipe frames are held together and tossed approximately 1 meter away. The two people then moved quickly to the trap to help secure the lower frame to the bottom with their feet. After estimating vegetative cover, fish are cleared from the trap with fine-meshed dipnets. The trap is swept until five consecutive passes of the dipnet yield no additional fish (Trihey and Associates 1996). Worcester (1992) constructed drop nets entirely of 1/16 inch mesh knotless nylon netting or fiberglass screening to prevent larval fish from being lost.

Throw traps are easier to use in vegetated areas than the beach seine and are capable of capturing smaller fish due to the finer mesh size. A seine with finer mesh could capture smaller fish, although the smaller mesh would increase water resistance, which could affect seine effectiveness (Trihey and Associates 1996).

Drop nets and traps have been used to sample nursery habitats (Kahl 1963; Kjelson and Johnson 1973; Kushland 1974; Turner and Johnson 1974; Kjelson 1977). Kushlan (1974) discussed the difficulties and advantages of various drop trap designs with respect to size, portability, and effectiveness. Chamberlain (1988) designed and constructed 2 m x 2 m traps with wood frames and transparent plastic panels to avoid attracting or frightening fish by shadow casting. Trihey and Associates (1996) reported results indicating higher variability among drop trap samples than among seines. Worcester (1992) reported 1/8 inch Delta mesh style knotless nylon netting as too large to contain larval fish. The entire trap was lined with fiberglass window screening to ensure that no fish would be lost through the netting.

Fong (1997) recommended a sample area of roughly 10 square meters seemed as optimal; it balanced the variability associated with small sample area that plagued the drop traps against greater than 1 hour processing times needed for sample areas much greater than 10 square meters.

2.3.3 Dip Net

Worcester (1992) used dip nets to remove fish from within the drop traps, both by visual observation and by blind sweeps of the net. Irwin *et al.* (1984) employed dip nets where the use of seines was impractical. Swift *et al.* (1997) used fine-meshed dip nets on occasion. Goldsmith (pers. comm.) found dip nets to be effective where submergent and emergent vegetation or the small size of the water body makes the use of seine nets difficult.

2.3.4 Hand-towed ichthyoplankton net

Wang (1982) and Wang and Keegan (1998) report successful use of a hand-towed ichthyoplankton net with 0.5-meter mouth and 0.5-millimeter mesh to collect larvae, and juveniles. Planktonic larvae were captured in the shallow areas with an ichthyoplankton net and a fine-meshed beach seine. Juvenile and adult

tidewater goby inhabit the benthic level. Wang and Keegan (1998) attached the net to a bridle 2 meters in length and hand-towed it along an approximate 10 meter course at each station.

2.3.5 Minnow Traps

Lafferty *et al.* (1997) sampled using Gee's minnow traps. Six minnow traps (6 millimeter mesh), baited with dry dog-food, were set in the evening in 0.5-2 meter water and inspected the following morning. Swift (1997) occasionally collecting with Gee's minnow traps with either 1/4 inch (6 millimeters) or 1/8 inch (3 millimeters) mesh and fine-meshed dip nets. Although tidewater gobies sometimes occur in unbaited traps with 3 millimeters mesh, it is extremely unusual to find them in the baited traps with 6 millimeters mesh, even in areas where they are extremely abundant Swift (1997), suggesting that gobies escape easily from the larger mesh.

2.3.6 Snorkeling and Direct Observation

Worcester (1992) concluded snorkeling is not feasible for the tidewater goby due to its small size, schooling tendencies, and cryptic nature. The variable nature of the habitat, often with very murky or heavily vegetated water, also precludes direct observational techniques (Worcester 1992). Swenson (1995) reported some success in observing gobies from the shore in shallow water (40 to 100 centimeters) or while snorkeling, but turbidity prevented extensive field studies using these methods. Holland (1992) conducted snorkeling surveys to qualitatively assess the numbers and distribution of gobies in standing water ranging from a maximum depth of 0.9 to 1.0 meter in 1990 to a maximum of 0.75 meter in 1991. Water turbidity was high in 1990 and effectively precluded snorkeling, but visibility was greater than 0.6 meters in 1991 and a snorkeling survey was successful (Holland 1992). However, Worcester (1992) observed at least 100 tidewater gobies in water approximately 3 inches deep on top of a concrete bridge abutment during a snorkeling survey in February, 1990.

Swift *et al.* (1994) examined some areas by swimming transects about 1.0 meter wide with mask and snorkel. A snorkeled transect 270 meters long and 1.0 meter wide recorded 2 tidewater gobies. However, the resulting density of 0.0074 tidewater gobies per square meter and an estimate of 126 fish in the sampled lagoon was much lower than documented with seine hauls. They also report other localities as too turbid for snorkeling. Estimates based on snorkeling were found to be much lower than those based on seining. All population estimates in their report are based on seine collections.

2.3.7 Plastic tubes

Swenson (1995, 1996b) collected adult tidewater gobies in artificial burrows made of polyvinyl chloride pipe tubes (13 millimeter inner diameter, 13

centimeters long). Plastic Duraleen (available at art supply stores) or other thin plastic sheet, 13.0 centimeter by 5.5 centimeters, was rolled up inside the tube as a liner to collect the adhesive eggs. McGehee (1989) and Bechler *et al.* (1990) report gobies readily adopt plastic tubes as artificial burrows, both in lab aquaria and in the field. "Tube trapping" is a useful method to collect breeding fish, to quantify reproductive output, and to determine the timing and intensity of spawning. The open-ended tubes are shoved into the sediment at an angle of approximately 30 degrees until the lower lip rested at the surface of the substrate (Swenson 1995). Sets of 10 tubes are placed in the sediment in shallow water (less than 1 meter deep, preferably 20 to 50 centimeters deep) at each habitat site (Swenson 1995). Tubes are spaced up to 1 meter apart to minimize territorial interactions by males. Tubes are left in the substrate 14 to 28 days to allow colonization by nesting males.

2.3.8 Sample Size

Fong (1997) estimated 48 and 33 beach seine hauls would be required for two sample regions to obtain density estimates within 20 percent of the mean with 90 percent confidence, based on data reported in Trihey and Associates (1996). Assuming that each seine haul would take an average of 45 minutes, a total of 61 sampling hours would be required for just two regions. In addition to the amount of time involved, this heavy sampling intensity would result in impacts to the tidewater goby habitat. For their purposes, the sampling effort was generally less than 5 seine hauls per region. Trihey and Associates (1996) recommended that sampling effort should consist of 3 to 5 seine hauls per site and 5 to 10 drop trap samples. Swift *et al.* (1997) recommended that to detect seasonal changes in populations, collections in lagoons be repeated bimonthly.

2.3.9 Sampling Season and Timing

Fong (1997) reported that October sampling indicates higher fish abundance occurs in the fall rather than the winter sampling period. Overall, mean densities of gobies increased from 1.7 per square meter to 35 per square meter.

Swenson (1995) conducted sampling in the morning at high tide (plus 4.7 feet). Because the water was too deep to effectively sample the main creek, a second survey was conducted in the morning during low tide (plus 1.8 feet), using a bag seine.

To detect seasonal changes in populations, Swift (1997) collected in lagoons bimonthly. Upstream tributaries were sampled for gobies intermittently to assess the degree to which tidewater gobies utilized these areas.

2.3.10 Density

Trihey and Associates (1996) reported tidewater goby density as extremely variable both across and within most sampling factors: method, location, vegetation and substrate. Mean density was 12.5 tidewater gobies per square meter for throw traps (standard deviation = 22.6, range 0 to 91, n = 70) and 2.0 tidewater gobies per square meter for seine samples (standard deviation = 3.6, range = 0 to 14.2, n = 26). Although the capture method alone did not significantly affect tidewater goby densities, the project's main objective was to test sampling methods and therefore the authors decided to treat trap and seine data separately for further analyses. Location within the lagoon significantly affected tidewater goby density for both methods. Substrate type and vegetation significantly affected densities of tidewater gobies caught with the throw traps but not with seine. Depth and distance from the shoreline also affected tidewater goby density. Tidewater gobies were more abundant in waters 50 to 100 centimeters deep and within 30 meters of the shore. Tidewater gobies were not collected in waters less than 20 centimeters deep or from nearshore sites. Swenson (1995) reported tidewater goby density varied tremendously among the five drop net samples (0 to 198 tidewater gobies per square decimeter). Density was greater in vegetated areas; the difference was not significant but the small sample size may have been too low to reject the null hypothesis (Swenson 1995).

2.3.11 Salinity

Swenson (1994) reported on the use of an Atago hand refractometer to measure salinity. Water temperature (degrees Celsius) and salinity (parts per thousand) were measured at the surface and on the bottom (approximately 50 to 70 centimeters deep).

2.4 Suitability of Habitat

Lafferty *et al.* (1999) reported known locations where apparent extirpations were followed by evidence of recolonization (Lafferty *et al.* 1999). Based on this information, we assume that all sites known to be previously occupied by gobies will be considered suitable and occupied without clear evidence that the site has been modified to the point where recolonization is highly unlikely, barring habitat restoration that successfully restores habitat conditions and ecosystem functions to conditions similar to a time of known tidewater goby occupancy.

3. Application of the Recommended Protocol

3.1 General Intent of the Protocol

The general intent of the protocol described in section 4 of this document is to provide a methodology of surveying for tidewater gobies in likely natural and human-made habitats at an intensity and effectiveness that ensures a high level of

confidence in finding gobies should they currently exist at the site. A secondary intent of the protocol is to prescribe a sampling regime or methodology that avoids placing an onerous and unreasonable burden on any project proponent who seeks to work in habitats likely to be suitable to the species.

The methodology described below is intended to document the presence or absence of tidewater gobies to a reasonable level of certainty, and to provide basic information on habitat affinity of the species. This methodology is not intended to be of sufficient intensity to estimate population levels, recruitment rates, or survival rates; habitat affinities more appropriate for research studies; population viability analyses; or other parameters associated with research-level activities. The parameter of interest in these surveys is a high likelihood of detecting gobies should they exist at the site.

We believe the following protocol will provide consistent results with a reasonable amount of effort. However, while we strongly recommend that potential surveyors adopt and implement our proposed protocol, we may consider other methods, on a case by case basis. The action agency or project proponent has the discretion to use any appropriate survey methodology to determine the presence or absence of tidewater gobies, provided they meet three conditions. First, any proposed protocol must meet or exceed the intended level of survey intensity and effectiveness of the protocol described herein. Second, surveyors proposing methods or intensities other than as prescribed here should seek concurrence on the proposed changes from our field office having jurisdiction over the proposed survey area. The proponent should seek this concurrence as early in the survey design as possible, and definitely prior to beginning actual field surveys. Finally, the surveyors must obtain any and all applicable Federal (described below) and State permits in advance of conducting the surveys.

3.2 Application of the protocol to projects

These guidelines are not intended for long-term monitoring or research projects or for determining the overall status of populations; guidelines for such monitoring and research efforts should be developed with our assistance on a case-by-case basis. We have worked with, and will continue to work with Federal, State, and local biologists; scientific and academic institutions; commercial organizations; and other interested parties to collect additional data on the distribution, ecology, and biology of the tidewater goby. We will revise this survey protocol as needed, using the best available data.

This protocol should fulfill the needs of landowners and managers to complete pre-disturbance surveys for tidewater gobies that provide a reasonable basis upon which to make effects determinations. Projects resulting in direct or indirect effects to tidewater gobies or their habitats should conduct surveys consistent with this protocol to document the presence or absence of tidewater gobies at their proposed project site. In addition, surveys conducted under this protocol may

provide useful information on the overall distribution of tidewater gobies within their range.

Extreme care must be taken when conducting surveys to avoid inadvertently injuring or killing tidewater gobies, or damaging their habitat (see Appendix F-3).

3.3 Peer Review of the Recommended Protocol

This protocol has been developed in conjunction with and reviewed by the Tidewater Goby Science Team, a group of agency and independent experts in tidewater goby biology and research. The protocol includes their comments. Any survey that uses a different methodology from this protocol should include a detailed description of the procedures used and an evaluation as to whether the conclusions drawn constitute the best available scientific and commercial information.

4. Recommended Protocol

We recommend the following survey guidelines be used to determine, with some reasonably high level of confidence, the presence or absence of tidewater gobies in habitat deemed suitable for the species.

4.1 Section 10(a)(1)(A) Recovery Permit Requirements

The survey methods prescribed in the following protocol require work within habitat likely to be occupied by tidewater gobies, and involves the handling of individuals for identification purposes. Although there is no requirement to preserve voucher specimens or otherwise directly kill individuals, the capture and handling of individuals has some risk of incidental mortality. Also, the methods proposed here require the surveyors to enter suitable habitat, and an unavoidable consequence of such activity is the trampling or other damaging of occupied burrows and mortality of eggs and possibly individuals. Therefore, all surveyors must obtain a recovery permit issued by us under section 10(a)(1)(A) of the Endangered Species Act of 1973, as amended. The permit application form and instructions for completion are available at the website <http://forms.fws.gov/3-20055.pdf>.

4.2 Survey Equipment

Surveys should be conducted using appropriate equipment. If other equipment is to be used, surveyors should contact our appropriate field office to determine if the other equipment is suitable for use under this protocol. The following equipment is the minimum necessary for conducting tidewater goby surveys under this protocol:

- U.S. Geological Survey quadrangle 7.5 minute series (topographic)

- map(s);
- ❑ global positioning system unit or other method to identify latitude/longitude of tidewater goby and sampling locations to within 10 meters of actual location on topographic maps or aerial photos;
- ❑ refractometer or electronic salinity meter;
- ❑ a fish identification guidebook or field-ready identification card with pictures of similar species;
- ❑ long handled dipnet with a frame opening greater than 0.1 square meter and mesh size less than 3 millimeters;
- ❑ 3 meters length by 1 meter deep seine (approximately 3 millimeters mesh), recommended for small habitats (described below);
- ❑ 5 meters length by 1 meter deep seine (approximately 3 millimeters mesh), recommended for medium to large habitat areas;
- ❑ minnow traps with approximately 3 millimeters mesh, unbaited;
- ❑ field notebook;
- ❑ camera;
- ❑ thermometer;
- ❑ meter stick; and
- ❑ a goby viewing device (*e.g.*, clear plastic bag or small jar).

In order to prevent the unintentional introduction of nonnative organisms or disease, sampling gear should be thoroughly cleaned, and dried if possible, prior to use in different watersheds.

4.3 Site Assessment

The area to be sampled for tidewater gobies should include appropriate habitat consisting of slow moving water bodies, generally less than 3 meters (10 feet) in depth, with suitable substrate and appropriate water quality parameters. The size of the discrete water body (lagoon, pond, stream, ditch) under investigation will be used to determine the corresponding sampling effort to be carried out.

For the purpose of selecting appropriate equipment, and determining sampling effort, water bodies are categorized by size as large, medium, and small. Large water bodies are those meeting at least one of the following general physical parameters: streams with channel bankful widths in excess of 20 meters (66 feet) at any point and/or with estuarine (areas with salt water intrusion) habitats exceeding 1 kilometer (0.6 mile) in length; or lagoons and ponds larger than 2 hectares (5 acres) surface area. Medium sized water bodies include smaller streams less than 20 meters bankful width and/or estuaries longer than 100 meters (328 feet) but less than 1 kilometer in length. Medium sized lagoons and ponds are those with a surface area less than 2 hectare, but larger than 0.4 hectare (1 acre). Small water bodies are the remaining streams, ditches, sloughs, lagoons, and ponds of lesser dimension than as described for the medium size range.

Immediately prior to conducting in-water goby sampling activities, surveyors should complete the following actions:

1. Take one or more overview photos from a vantage point that provides an oblique view of the sampled habitat (when possible). The location(s) should be consistent from year to year if future surveys are anticipated.
2. Record the percent cover of aquatic vegetation and identify common plant species present in the area actually surveyed.
3. Categorize the water body, including size (as defined above).
4. Measure the average depth of the water using the meter stick for each sampling effort.
5. Record water temperature at a depth of half the average water depth in the survey area.
6. Take salinity measurements at both surface and bottom depths with the salinity meter or refractometer.
7. Note any unusual characteristics of the environment.
8. Record all other pertinent information describing date, time, location, names of surveyors, *etc.*

4.4 In-water Sampling for Tidewater Gobies

Before sampling, we recommend the surveyors review the literature and agency records for historical information and other available resources, and including communication with species experts. This review should determine whether populations have been previously identified at or near the site to be sampled, or whether suitable habitat for tidewater goby exists at the site. This information should be summarized in the survey report (see section 5, below).

In the absence of recent survey data, any site known historically to have been populated with tidewater goby should be assumed to be currently occupied by the species, unless clear evidence indicates that the habitat has been so modified as to be uninhabitable.

For the purpose of this protocol, the presence of one individual tidewater goby resulting from surveys constitutes evidence of an extant population. This determination is based on the annual life cycle of the species, the difficulty in detecting tidewater gobies, and the low likelihood of only one individual to be present in a watershed.

4.5 Survey Methods

Several methods can be effective in identifying, or capturing tidewater gobies. The following methods are recommended for conducting surveys, and each one is best suited to particular types of water bodies.

To maximize the probability of capture, and to ensure that the highest quality habitat within the area of interest is surveyed, sampling should be segmented into multiple locations within any water body. For purposes of this protocol, the “area of interest” is defined as that portion of the water body wherein the presence or absence of gobies is to be documented. For general surveys, the area of interest is likely to be the entire water body. For water bodies proposed to be altered by a project or other action, the area of interest is that portion of the water body likely to be affected (adversely or beneficially) by habitat loss, alteration, disturbance, sedimentation, or any other physical or biological factor directly or indirectly affecting suitable habitat of the species.

When surveying large water bodies, surveys should adequately cover all suitable habitat within the area of interest. We recommend surveying in a minimum of five distinct separate areas throughout the suitable habitat in large water bodies. When surveying small and medium water bodies, at least three distinct areas within suitable habitat should be sampled. In all water bodies, the saltwater/freshwater interface should be included in sampling locations, because gobies are often located in this zone. The following information should be used as a guide to complete the required amount of sampling effort. The effort categorized in the table below represents minimum acceptable numbers. In all size categories of water bodies, it is important to sample in the area where the impacts from the proposed project would be significant, and especially important in the large water bodies, where only a small percentage of the water body is surveyed. If the water body supports fishes, surveyors may begin sampling with the dip net if and where appropriate. Surveyors should record the presence of other identifiable fish and invertebrate taxa captured or observed, as part of general comments for each water body surveyed. Dip nets are especially important in those portions of suitable habitat where emergent and submergent vegetation or substrate limits or precludes the use of seine nets. For those habitats where seine nets cannot be used effectively, dip nets may be the only method that can be effectively employed. The table above indicates the amount of time that should be dedicated to the use of dip nets. Where seine nets can be used effectively, the amount of dip netting required is identified in the column labeled “Supplemental.” In those water bodies where seine nets cannot be used, the dip netting may be the sole method that can be used effectively. The minimum time allocated to dip netting for sole method sampling is identified in the table below. For instructions in minimizing effects to gobies from sampling see Appendix F-3.

Water Body Size	Number of Minnow Traps per 24 hour sampling period/ number of sampling periods	Seine hauls (minimum effort required)	Dip Netting (minutes of effort)	
			Supplemental	Sole Method
Large	12/2 (minimum)	25 per 10 hectares	20	120 per 10 hectares
Medium	Not required	15 per water body	10	90 per water body
Small	Not required	15 per water body	5	60 per water body

Where site conditions allow effective use of a seine, surveyors should attempt to cover a minimum of 30 square meters per seine haul, with a recommended average of 50 square meters per seine haul. The number of seine hauls may be limited by suitable sites, and is dependent on the size of the water body.

For small and medium water bodies, conduct enough seine hauls to adequately cover suitable habitat. A minimum of 15 seine hauls is suggested to adequately cover these areas. Although some overlap between seine hauls is effective, they should have no more than 20 percent overlap in area. For any size water body, once tidewater gobies are detected, sampling may cease. In cases where the amount of suitable habitat within a water body can be covered completely by fewer than the prescribed number of seine hauls, sampling may cease when the water body is essentially 100 percent covered, or when tidewater gobies are first captured.

For large water bodies (as defined above), the number of seine hauls completed should be adequate to effectively sample the suitable habitat of interest. Since large water bodies may range from two to several hundred or more hectares, these water bodies only need to be sampled in the area of interest (as described above). Within the area of interest, the water body should be generally delineated into 10 hectare blocks of suitable habitat. The following survey recommendations apply within each 10 hectare block. We recommend a minimum of 25 seine hauls throughout a minimum of five sampling areas in each block. These 25 seine hauls should be distributed approximately uniformly across the five sampling areas (*i.e.*, five or more seine hauls across each of five or more sampling areas), or otherwise distributed among the five sampling areas to optimize the likelihood of detecting gobies within the suitable habitat of interest. For example, if two sampling areas are high quality habitat and three are lesser habitat, it may be best to complete eight seine hauls in each of the two best habitat areas, and three seine hauls in each of the three lesser habitat areas. Since conducting additional seine hauls in a sampling area represents relatively little additional work above that already necessary to do the minimum, additional seine hauls are encouraged whenever a question remains as to the possibility of tidewater gobies occupying the habitat.

If small fishes suspected to be tidewater gobies are found, surveyors should place them in viewing device and confirm the identification of tidewater goby (or other species) by looking for the clear tip of the first dorsal fin. If surveyors are in doubt, they should confirm fish identification by using a fish identification guidebook, and if possible, take photographs. Surveyors should record the location where gobies were sampled and the sampling effort expended to find them, to the nearest 10 meters. Surveyors should release the gobies promptly at site of capture and discontinue sampling (vouching new records or collections for other scientific purposes are appropriate if in accordance with the biologist's permits). Surveyors should also record the location of positive and negative survey results.

4.6 Sampling Period

Tidewater goby abundance fluctuates spatially and seasonally (Swenson 1999), due in part to their predominantly annual life cycle (see Background). Surveys must be conducted in two sampling periods between July 1 and October 31, due to this period being the time of highest abundance for the species in general, and therefore, the period of highest detection. The two sampling periods must be separated by at least 30 days to accommodate situations where changes in water level, seasonal movements, or other functions result in movement of gobies within the survey area. All surveys should be recorded and reported, including surveys that do not detect tidewater gobies. Surveyors should return to the same sites in sampling period 2 where tidewater gobies were not found in sampling period 1, but also include any suitable habitat that may have not been suitable during the first survey period due to changes in water level, *etc.* If tidewater gobies are found during the first visit, sites do not need to be sampled during the second period.

For surveys conducted as part of a project clearance, additional sampling may be needed prior to initiation of those project activities that may affect the tidewater goby. If gobies are not found within the two survey periods, and the project will not be completed within 60 days of the last survey, a pre-project survey may be required for any part of the proposed project area that may affect the tidewater goby. The need for this survey will be evaluated on a case-by-case basis between the applicant and our field office that has jurisdiction over the area of interest.

4.7 Area to Which Survey Protocol is Applicable

The survey protocol may be applied throughout the species range. Survey results are specifically applicable only to the actual body of water to which the survey is applied, but may be generally applied to similar water bodies contiguous to or immediately adjacent to the sampled habitats, provided a reasonable likelihood of connectivity between the sampled site and the sites to which the information is being extrapolated.

4.8 Effective Duration of Survey Results

Survey results are valid for 1 year. Based on input from several tidewater goby research scientists, due to the annual life cycle of the tidewater goby, documented population fluctuations, and their recolonizing ability, survey results are valid for a maximum of 1 year from the date surveys end.

Five consecutive years of negative survey results are needed to establish a history of absence. Proposed actions that span more than 1 year must be surveyed for each year of activity. Contact our appropriate field office (see Appendix F-1, below) for additional information before conducting surveys.

Surveys are not needed if surveys completed during the prior 10 years have confirmed the presence of gobies in waters with habitat contiguous to the habitat identified for survey AND the habitat where gobies were earlier found have not been substantially modified or impacted by human activities or natural events. That is, we presume that habitat previously occupied by gobies continues to be occupied unless clear evidence indicates that gobies have been extirpated.

The converse is not necessarily true. Habitats that have undergone sampling in the past, regardless of intensity, and been shown to be absent of gobies does not necessarily mean those habitats are currently devoid of the species. We will, however, consider the merits of scientific analyses on a case-by-case basis to analyze presumed absence of the species in otherwise suitable habitat. Those analyses should consider any past surveys done in that habitat, the intensity and coverage of those surveys, any modifications to the habitat since last known occupancy by the species, and the potential for the habitat to be recolonized by adjacent populations.

4.9 Other Permits and Permissions

Because this protocol (and tidewater goby surveys in general) involves capture, surveyors must have “take” authorization pursuant to section 7 or 10(a) of the Act to be exempt from the take prohibitions under section 9 of the Act. Surveys must be conducted by individuals possessing a 10(a)1(A) recovery permit from the Fish and Wildlife Service, specific to the tidewater goby. In addition, there may be permit requirements from the California Department of Fish and Game as well as other agencies to conduct surveys for gobies. Finally, surveyors should seek appropriate permissions from landowners or their managers to access or cross properties for their goby survey work, as needed. Nothing within this protocol should be construed as permission to enter, access, or cross any lands or waters not under the immediate control of the surveyor without specific permission from the affected landowner(s).

5. Reporting Requirements

Any permitted biologist observing a tidewater goby under this protocol is to notify our appropriate field office by phone (see Appendix F-1 for contact numbers) within 24 hours of such observation. Within 5 business days, the surveyor should fax or e-mail a copy of a U.S. Geological Survey quadrangle 7.5 minute series (topographic) map to the recovery permit coordinator in our appropriate field office, with the observation site clearly marked. Include a detailed description of the precise location of the tidewater goby(ies).

The permittee shall notify our appropriate field office in writing, at least 10 working days prior to the anticipated start date of survey work and receive approval prior to beginning work. Surveyors also should prepare a final report within 45 days that includes the following:

- ❑ Recovery permit number(s)
- ❑ Names of surveyors
- ❑ Location information, including county, watershed, GPS coordinates in either Latitude/Longitude or UTM NAD27 or indicated on a copy of a U.S. Geological Survey 7.5 minute topographic quadrangle map
- ❑ Photographs of the project site (photo points [locations and general direction] should be indicated on a map)
- ❑ A typed summary providing survey dates and times (both begin and end times)
- ❑ Habitat description (amount and quality of suitable habitat)
- ❑ The area sampled by a particular method (indicated on a map)
- ❑ Justification for areas not surveyed
- ❑ Effectiveness of seine hauls
- ❑ Number of tidewater gobies captured
- ❑ Photographs of tidewater gobies detected on site to verify species identification, (collection is not permitted without prior authorization)
- ❑ Other species detected
- ❑ Water temperature
- ❑ Salinity
- ❑ Whether area is currently tidally influenced
- ❑ A description of possible threats to tidewater gobies observed at the site including nonnative and native predators.

The report should be provided to our appropriate field office (see Appendix F-1).

Based on the results of surveys, we will provide guidance on how tidewater gobies should be addressed. If tidewater gobies are found, we will work with the project proponent through the section 7 (for Federal actions) or section 10 (for non-Federal actions) process. If tidewater gobies are observed but not identified to species, additional survey efforts may be recommended. If tidewater gobies are not found during the field surveys (conducted according to this protocol), we will consider the tidewater goby not likely to be currently present on the project site.

We may not accept the results of field surveys conducted under this protocol for any of the following reasons: 1) if our appropriate field office was not contacted prior to field surveys being conducted; 2) if field surveys were incomplete, or conducted in a manner that was inadequate for the area to be surveyed; or 3) if the reporting requirements were not fulfilled.

We encourage all surveyors to send any information on tidewater goby distribution resulting from surveys to the California Natural Diversity Data Base administered by the California Department of Fish and Game. Information about how to submit information to the California Natural Diversity Data Base is provided in Appendix F-2. Copies of the California Natural Diversity Data Base

form should be mailed in a timely manner to the California Department of Fish and Game, as well as our appropriate field office.

These individual survey reporting results are separate from, and do not replace or supersede, the annual report required of each endangered species recovery [section 10(a)(1)(A)] permit holder to report activities conducted each year under his/her permit.

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Appendix F-1. USFWS Field Office and Regional Office Contacts

Please contact the appropriate Fish and Wildlife Service field office, for the counties indicated below, to obtain local information about the tidewater goby or application of this survey protocol:

For San Diego or Orange County, or Los Angeles County south of the Santa Monica Pier, contact:

*Carlsbad Fish and Wildlife Office
Attn: Recovery Permit Coordinator
6010 Hidden Valley Road
Carlsbad, California 92009
Phone: (760) 431-9440
Fax: (760) 930-0846*

For Sonoma, Marin, Solano, Contra Costa, Alameda, Santa Clara, San Mateo, or San Francisco County, contact:

*Sacramento Fish and Wildlife Office
Attn: Recovery Permit Coordinator
2800 Cottage Way, Suite W-2605
Sacramento, California 95825
Phone: (916) 414-6600
Fax: (916) 414-6713*

For Santa Cruz, Monterey, San Luis Obispo, Santa Barbara, or Ventura County, or Los Angeles County northwest of the Santa Monica Pier, contact:

*Ventura Fish and Wildlife Office
Attn: Recovery Permit Coordinator
2493 Portola Road, Suite B
Ventura, California 93003
Phone: (805) 644-1766
Fax: (805) 644-3958*

For Del Norte, Humboldt, or Mendocino County, contact:

*Arcata Fish and Wildlife Office
Attn: Recovery Permit Coordinator
1655 Heindon Road
Arcata, California 95521
Phone: (707) 822-7201
Fax: (707) 822-8411*

For information on ESA section 10(a)(1)(A) recovery permits, please contact:

*Region 1, USFWS
Attn: Recovery Permit Coordinator
Eastside Federal Complex
911 N.E. 11th Avenue
Portland, OR 97232-4181
Phone: (503) 231-6241
Fax: (503) 231-6243*

Appendix F-2. General instructions for filling out California Natural Diversity Data Base field survey forms

The California Natural Diversity Data Base is the largest, most comprehensive database of its type in the world. It presently contains more than 33,000 site specific records on California's rarest plants, animals, and natural communities. The majority of the data collection effort for this has been provided by an exceptional assemblage of biologists throughout the state and the west. The backbone of this effort is the field survey form. We are enclosing copies of California Natural Diversity Data Base field survey forms for species and natural communities. We would greatly appreciate you recording your field observations of rare, threatened, endangered, or sensitive species and natural communities (elements) and sending them to us on these forms.

We are interested in receiving forms on elements of concern to us; refer to our free publications: *Special Plants List*, *Special Animals List*, and *Natural Communities List* for lists of which elements these include. Reports on multiple visits to sites that already exist in the California Natural Diversity Data Base are as important as new site information as it helps us track trends in population/stand size and condition. Naturally, we also want information on new sites. We have enclosed an example of a field survey form that includes the information we like to see. It is especially important to include a photo copied portion of a U.S. Geological Survey topographic quad with the population/stand outlined or marked. Without the map, your information will be mapped less accurately, as written descriptions of locations are frequently hard to interpret. Do not worry about filling in every box on the form; only fill out what seems most relevant to your site visit. Remember that your name and telephone number are very important in case we have any questions about the form. If you are concerned about the sensitivity of the site, remember that the California Natural Diversity Data Base can label your element occurrence "Sensitive" in the computer, thus restricting access to that information.

The California Natural Diversity Data Base is only as good as the information in it, and we depend on people like you as the source of that information. Thank you for your help in improving the California Natural Diversity Data Base.

Appendix F-3. Techniques to Minimize Effects to Tidewater Goby from Surveys

General Guidelines

When conducting sampling for tidewater gobies, particular care should be taken when walking in suitable habitat to minimize disturbance to the area, especially during breeding periods, when gobies in burrows could be crushed as a result of being stepped on. Entry to the water should be slow, and where possible, visually scan for gobies before entry. This precaution should also be taken when launching and retrieving of boats as part of sampling efforts. When captured, tidewater gobies should never be completely removed from water, and should remain completely wetted at all times. All individuals captured should be released immediately after identification at the point of capture. Any tidewater gobies exhibiting signs of physiological stress shall be immediately released. As part of the presence/absence survey, measuring gobies is neither required nor recommended. Tidewater gobies shall not be anaesthetized, stained, dyed, or otherwise marked at any time. Electrofishing is not an authorized sampling method for tidewater gobies.

Seining

Disturbance and damage to burrows, eggs, and young should be minimized through use of the smallest and lightest weight seines practicable that meet protocol guidelines. It is important to avoid accidental injury or mortality to tidewater gobies, which may be caught and suffocated in vegetation such as algal mats or other debris when using seines. Rocks should be removed from seines immediately, otherwise tidewater gobies may be crushed by rocks tumbling and rolling in the seine. Bagged portions of seines must remain in the water until all tidewater gobies are removed. Temporary holding containers, if used, should be shallow, filled with clean water, and be placed in a location that will not result in exposure to extreme temperatures.

Dip Netting

When using dip nets, a container of water collected from the immediate vicinity of the tidewater goby capture should be available to immediately transfer gobies into when captured.

Traps

When setting minnow traps, place them in areas where anticipated tidal or upstream water volume fluctuations will not dewater the trap, or expose it to poor water conditions as a result of location. When checking traps, all contents should immediately be transferred to a container of water from the immediate vicinity before identifying fish species.