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[Article]

Description and Initial Evaluation of a Text Message Based Reporting Method for Marine Recreational Anglers

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Abstract.—Despite the large number of marine recreational anglers in the United States, there exist few opportunities for individuals to contribute self-reported effort and catch data directly to fisheries managers. Successfully implemented data collection programs based on self-reported information have been able to provide scientists with additional indices for comparisons with existing fisheries data sets and to increase angler participation and confidence in the fisheries management process. Limitations to self-reported data aside, the lack of a portable, electronic reporting device for the average angler has hindered development of new survey methods. We have developed a simple but fully customizable reporting method by which users can submit basic effort and catch information to an online database via text messages from mobile phones. To evaluate this new approach, we asked captains on behalf of six marine for-hire operations to send a text message to document effort, catch, and disposition of catch by species at the completion of each for-hire trip. Report submission was facilitated by RECTEXT, a compact syntax we developed to allow users to submit information within the technical limitations of a 160-character text message framework. During the course of the 4.5-month evaluation, participants submitted 128 trip-level reports that described 1,957 finfish interactions. Results and feedback from participants indicate that the approach is easy to use, is cost efficient, and allows for real-time reporting of information directly to an online database. In addition to the electronic angler diary application described here, we suggest that future evaluations of this approach be applied to tournament data collection, as the real-time nature of reporting and the organized structure of tournaments may provide a mechanism to both interact with all registered anglers and facilitate design of an unbiased sampling protocol for validating the self-reported data.

One of the most difficult issues in fisheries management today is the quantification of marine recreational effort and catch data. In 2007, in the United States alone, approximately 12 million anglers participated in 83 million marine recreational fishing trips (National Marine Fisheries Service, Fisheries Statistics Division, personal communication). As a consequence, catches attributable to marine recreational anglers have become a significant portion of the total landings for many species. The magnitude of this impact is no longer trivial, and for some species—particularly in the southeastern United States—recreational fisheries landings exceed the commercial harvest (Coleman et al. 2004).

For most marine species in the United States, fishery-dependent estimates of angler effort and catch are collected by the National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries) Marine Recreational Fisheries Statistics Survey (MRFSS; Essig and Holliday 1991). Originally designed as a national survey to characterize trends in marine recreational fishing activity, MRFSS data are often a primary data source for marine stock assessments. With the passage of the Magnuson–Stevens Fishery Conservation and Management Reauthorization Act of 2006, NOAA Fisheries must now rely on MRFSS data to end overfishing by 2011 for all managed recreational species. This is troubling considering that a recent independent review of MRFSS determined that the program had serious flaws in both design and implementation (NRC 2006). Although NOAA Fisheries has initiated a new national survey program called the Marine Recreational Information Program to replace MRFSS (NOAA Fisheries 2008b), there has been little movement to establish angler data collection programs to augment existing scientific surveys. Of the 528 total domestic stocks managed by NOAA Fisheries, 284 stocks or stock complexes either (1) have overfishing thresholds that are not defined or applicable or (2) have an unknown

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overfishing status (NOAA Fisheries 2008a). Research has shown that structured angler self-reporting programs with backing by both users and survey administrators can provide an additional data source for fisheries management purposes (Pollock et al. 1994; Cooke et al. 2000; Loftus et al. 2000) and include more anglers in the data collection process.

Self-reported data are generally accepted as the most economical way to characterize a particular fisheries sector. Despite the cost savings, most self-reported data, if collected off-site, are difficult or impossible to validate, leaving them vulnerable to criticism (Pollock et al. 1994; McCluskey and Lewison 2008). As this type of data is not often used a sole source of information to manage a fishery, it is typically used for comparison with components of existing scientific surveys or to examine trends of differences between areas (Pollock et al. 1994). Research studies using self-reported data have been able to complement and validate research surveys (Ebbers 1987; Starr and Vignaux 1997), document trends in species abundance or absence in the fishery (Gartside et al. 1999; Campbell et al. 2003), and evaluate long-term management measures on fisheries resources (Mosindy and Duffy 2007). In addition, self-reported data programs function like cooperative research programs in that they can increase anglers' confidence in the management process (Cooke et al. 2000; Lucy and Davy 2000; Gouveia et al. 2004; Johnson and van Densen 2007).

The method of data collection has also been cited as a contributing factor to the success or failure of self-reporting programs (McCluskey and Lewison 2008). Programs utilizing an electronic reporting approach would allow for immediate data entry and faster assimilation by end users. As portable computers are still relatively expensive for implementation into self-reporting programs, basic mobile phones may be an additional mechanism by which anglers could submit self-reported data to an online database from the field.

Mobile phone usage in the United States, including the use of the Short Message Service (SMS), commonly referred to as "text messaging," has steadily increased throughout the United States in recent years (CTIA–The Wireless Association 2008). The SMS allows for mobile phone users to exchange short text messages of up to 160 characters in length between subscribers via mobile communication networks. Those messages, however, can be redirected or forwarded to additional destinations, such as e-mail, instant messaging, and internet applications (Brown et al. 2007). Text messaging has been recently used in several resource management applications, including the real-time tracking of marine mammals (McConnell et al. 2004; Cronin and McConnell 2008), and as a mechanism to deliver real-time fish pricing information to fishermen operating near shore (Jensen 2007).

This study was undertaken to develop and initially evaluate a simple electronic fisheries reporting system for individual recreational anglers based on text messages sent from mobile phones. Our specific objectives were to (1) develop a data collection system such that participants could submit effort and catch reports from standard mobile phones to a central database; (2) facilitate system use and minimize reporting errors by developing instruction materials and a reference guide for participants; (3) evaluate the system using for-hire captains over an extended period of time; (4) provide summary statistics for the data received; and (5) gather feedback from participants on the operational aspects of the system.

Methods

System design and implementation.—The reporting method described here was developed partially in response to the growing demand for low-cost, real-time data collection methods as suggested in the review of the MRFSS (NRC 2006). While it is impossible to address all the design issues that may arise when incorporating new technology into data collection activities, we designed this approach to be an initial step towards the development a self-reporting method for the marine recreational fisheries sector, including captains of for-hire operations and individual recreational anglers. The reporting method described here was envisioned to be as simple as possible yet allow for flexibility in the development of data-specific applications, including those other than fisheries applications. The system uses freely available, off-the-shelf components, services, and technologies. To that end, this data collection method is based on four primary components: mobile phones, an operating language or syntax developed for this project, a text message aggregating service, and a database to archive and display reports submitted by participants.

Mobile phones.—Mobile phones were selected as the data submission device, as opposed to other forms of electronic devices (i.e., smartphones, laptop computers, etc.) for several reasons, including (1) their existing ownership and daily use by a large number of users, (2) portability, (3) low cost to own and operate, (4) real-time data submission capability via text messaging, and (5) the global growth in mobile phone coverage, usage, and emerging applications. Prepaid mobile phones were utilized for several reasons. First, we assumed that use of the same model phone by all study participants would largely eliminate typing errors that might be associated with text message transmis-

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sion on multiple wireless devices. Second, use of identical phones allowed us to develop a universal reference guide for participants describing system use and text message procedures. Third, although text messages are relatively inexpensive to send or receive (SMS industry average is US$0.11; Wikipedia 2009b), we did not want cost to be a factor in the participants' decision to submit reports. The use of prepaid mobile phones obviated all of these concerns. We selected the Motorola C139 mobile phone from www.TracFone.com because of its low cost, long battery life, and inexpensive text message rate plan. We determined that these phones had excellent reception and could be used several kilometers offshore, if needed. Although we did not determine the maximum range of these phones, we felt that this was irrelevant to our study as we asked participants to submit reports only at the completion of trips.

System syntax and coding.—We configured this pilot system to allow for the reporting of effort and catch data that are necessary to characterize the fishing activities of marine recreational anglers. Each text message fishing report, submitted at the completion of a trip, consisted of three required components and one optional component: (1) total number of anglers that fished; (2) total number of hours spent fishing; (3) quantity and disposition of catch (kept or released) by species; and (4) optional total length measurement (in) for single observations.

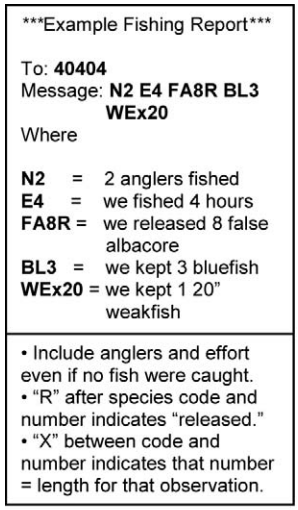
To make reporting as easy as possible, we developed a compact syntax, RECTEXT, allowing participants to report effort and catch information via text message. The RECTEXT syntax is composed of one- and two-letter codes and numbers that can be used to describe and quantify fishing activity. Initially, species codes from the comprehensive MRFSS list were considered for this study, but these were dismissed because they were too long and complex for repetitious data entry by participants. As the system was designed for anglers and not scientists, we felt that a simple, intuitive syntax would minimize reporting time and typing errors on the small keypads of mobile phones. Using RECTEXT, number of anglers and effort expended were indicated by a single "N" and "E," respectively, prior to the number. The species or species groupings generally encountered by marine recreational anglers in our area were indicated by unique two-letter codes prior to the number of observations for that particular species or group. For example, "RD2" would indicate that the angler kept two red drum *Sciaenops ocellatus* at the completion of that particular fishing trip. Fish that were released instead of kept were identified by the inclusion of a trailing "R" after the species code and observation combination (i.e., "RD2R"). Finally, we gave participants the option to include a total length measurement in inches for a single species observation by placing an "X" between the species code and the total length measurement. Although data fields did not have to be entered in any particular order by participants, we did require that a space be inserted in between each data field to facilitate automated parsing of the data into our database. The codes used and an example of a typical fishing report can be seen in Figure 1.

Text message aggregator service.—The foundation of this pilot-scale reporting system is www.Twitter.com, a free social networking service that enables registered users to send and receive short messages (up to 140 characters) from friends using SMS, e-mail, instant messaging, and internet-based data entry. Twitter is the third-largest social networking site in the world and has approximately 6 million unique monthly visitors and 55 million monthly visits (Wikipedia 2009a). Among other capacities, Twitter essentially functions as a text message aggregating service. Because Twitter supplies a unique identification number to each message it receives, it is possible to associate individual text messages to the users who submitted them. Like many websites, Twitter allows all messages, once received, to be sent real-time to other websites via a syndication technology called Really Simple Syndication (RSS).

To submit data using this approach, registered participants composed text messages by using the RECTEXT syntax and submitted them to the aggregating service, Twitter, where the messages were stored ephemerally. From our website, we were able to query and receive the RECTEXT reports from Twitter as Extensible Markup Language (XML). The XML data were transmitted from Twitter to our website by RSS via Hypertext Transfer Protocol. Once received, we parsed the XML for the appropriate data, translated the RECTEXT into recreational fishing information, and populated a relational database (MySQL). Finally, the database was made available to web users via the Hypertext Preprocessor scripting language and Hypertext Markup Language. A generalized overview of the reporting system can be seen in Figure 2.

Local database to store RECTEXT reports.—Once text messages were received by the data aggregator, raw data were parsed as XML, translated into data fields, and stored in a relational database (MySQL) in the order received. This step not only eliminated postprocessing on behalf of the survey administrator but also allowed the data to be easily comprehensible to anyone who viewed the data from the website. The website for this pilot project is viewable at www.rectext.org. At the website, visitors can practice using the RECTEXT syntax by clicking on the mobile phone

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Species	Code	Species	Code
Albacore, False	FA	Perch, Silver	PE
Amberjacks	AM	Pigfish	PI
Barracuda	BA	Pinfish	PN
Bass, Striped	SB	Pompano	PP
Bluefish	BL	Porgy, Red	RP
Bonito	BO	Porgy, Whitebone	WP
Cobia	CO	Porgies, Other	OP
Croaker, Atlantic	CR	Sailfish	SA
Dolphin	DO	Sea Bass, Black	BS
Drum, Black	BD	Shad, American	AS
Drum, Red	RD	Shad, Hickory	HS
Eel, American	EE	Shark, Blacktip	TS
Flounder, Southern	FL	Shark, Dogfish	DF
Flounder, Summer	SF	Shark, Sharpnose	SS
Grouper, Gag	GG	Sharks, Other	OK
Grouper, Red	RG	Sheepshead	SD
Grouper, Scamp	SG	Snapper, Red	RS
Grouper, Snowy	SN	Snapper, Vermilion	VS
Grouper, Warsaw	XG	Snappers, Other	OS
Groupers, Other	OG	Spot	SP
Grunt, White	WG	Tarpon	TA
Grunts, Other	ON	Triggerfish, Gray	TR
Jacks, Other	OJ	Trout, Speckled	ST
Kingfishes	KI	Tuna, Blackfin	BT
Mackerel, King	KM	Tuna, Bluefin	BF
Mackerel, Spanish	SM	Tuna, Other	OT
Marlin, Blue	BM	Tuna, Yellowfin	YT
Marlin, White	WM	Wahoo	WA
		Weakfish	WE

FIGURE 1.—A portion of the 19.2 × 8.8-cm reference guide given to study participants submitting angler effort and catch data via RECTEXT.

image under the "Demo" heading. Use the keyboard to compose a message following the example given, and press enter to the see the results at the bottom of the page. Visitors can also view an example of one participant's effort and catch history by clicking on the image under the "Example Report" heading. Although not necessary for our evaluation, the database could easily be configured such that users could log in to see their personal history and sort by species, trip, and month.

Effort and catch statistics.—Other than the data listed above, study participants were not asked to identify a target species for each trip or to identify their fishing location. As all participating captains primarily operate in the same geographic region, we assumed that in this study, all fishing activity occurred in brackish and marine waters in southeastern North Carolina. We defined catch as all fish that were caught or released. For the same reason, in our calculation of mean catch per angler-hour fished for each trip, we defined angler-hour as the number of anglers that fished multiplied by the total number of hours fished.

Study participants.—Captains of local for-hire operations, who would be submitting reports on behalf of their fishing clients, were asked to evaluate the reporting system because we felt that this group would be able to use the system more frequently in this time-limited trial than would the general angling public. By maximizing the number of submissions during the study period, we were able to look for trends, reporting patterns, and possible errors in submission and reception of fishing reports. Therefore, we were more concerned with system use and reporting error on behalf of the participants rather than the overall rate of reporting. During the study period, participants were asked to submit a RECTEXT report at the completion of each trip, documenting the number of fishing clients (anglers), number of hours spent fishing, and the species, number, and disposition of finfish captured. A $100 honorarium was provided to each participant, considering that the trial was expected to last for several months.

We determined that in order for the system to function as smoothly as possible, we would need to train study participants on text message data submission and to develop a convenient reference guide and an example fishing report. A foldable, wallet-sized (19.2 × 8.8 cm) reference guide was developed and

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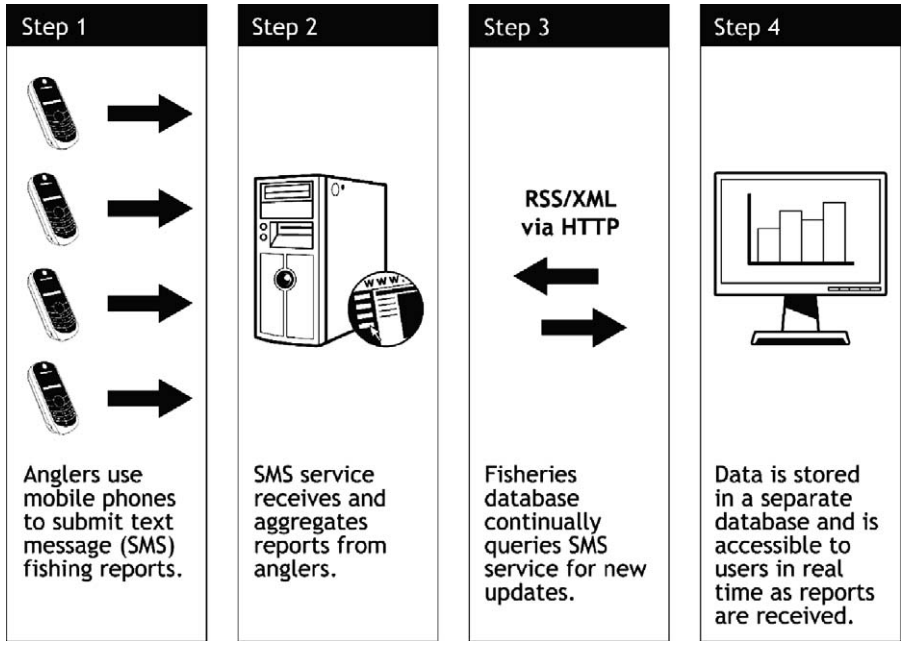


FIGURE 2.—Diagram of the text message reporting infrastructure used in this study (SMS = Short Message Service; RSS = Really Simple Syndication; XML = Extensible Markup Language; HTTP = Hypertext Transfer Protocol).

given to participating captains (Figure 1). Each participant was shown how to use the system, and we supervised a few practice submissions on the prepaid phone (if necessary) during our initial consultation.

To assess the potential of this method, all six participating captains were asked to complete a voluntary survey prior to and after the 4.5-month trial period. The presurvey focused on two topics: (1) mobile phone usage, including text messaging; and (2) general questions related to the individual's fishing business. Minimal personal information was also collected from each individual. The postdata collection survey asked for overall opinions about the training received, reporting frequency, overall usability, and potential applications of the system.

Results

Preliminary Survey

One participant (7096) operated a larger vessel (10 m) and primarily fished offshore in U.S. federal waters (4.8–322.0 km), whereas the remaining five individuals operated smaller center-console vessels (<7.6 m) and offered inshore and nearshore (0.0–4.8 km) charters. Participants in the study reported that they took, on average, between 40 and 200 for-hire fishing trips per year. Full-time professional fishing experience ranged from 5 to 16 years. While all six participants were comfortable with mobile phones and used voice services anywhere from 10 to 50 times/d, reported use of other applications on mobile phones was minimal. Four of the six participants indicated that they had sent at least one text message before the study began, while only three individuals used text messaging on a daily or weekly basis. The two participants who had never used text messaging before were, however, aware of the technology.

Effort and Catch

All fishing activity took place in estuarine and marine waters of southeastern North Carolina. Text message fishing reports were submitted between March 15 and July 31, 2008. The number of fishing reports submitted per participant ranged from 5 to 40. Over the course of the study, six individuals submitted 128 text message fishing reports on behalf of 326 fishing clients (anglers). One individual (9950) indicated that only 20% to 40% of trips were reported, and another individual (4338) dropped out of the study after April; the remaining four participants indicated that all fishing trips and finfish encounters were reported during the study period. The mean number of anglers taken per trip varied by participant, as did fishing effort (Table 1).

A total of 1,957 finfish representing 28 of the 57 species or species groupings included in the REC-TEXT syntax were reported by participants. The most

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TABLE 1.—General effort and catch characteristics derived from text message fishing reports submitted by six for-hire captains operating in southeastern North Carolina from March 15 to July 31, 2008. Mean results are reported with SDs.

Captain code	Total trips reported	Mean number of anglers	Mean fishing effort (h)	Total fish kept	Total fish released	Mean catch per trip	Catch per angler-hour fished
7105	25	2.0 ± 0.9	4.8 ± 1.0	7	389	15.8 ± 12.9	1.7 ± 1.1
7096[a]	10	4.1 ± 1.7	6.1 ± 4.0	277	12	28.9 ± 20.9	2.4 ± 2.5
6188	40	2.5 ± 0.7	4.8 ± 1.0	272	276	11.7 ± 8.2	1.3 ± 0.9
4372	29	2.5 ± 0.6	4.2 ± 1.1	262	27	10 ± 11.7	0.9 ± 1.0
9950	5	1.8 ± 0.4	4.4 ± 0.9	4	23	5.4 ± 2.5	0.8 ± 0.4
4338	19	2.9 ± 0.9	5.1 ± 0.9	301	107	21.5 ± 21.0	1.5 ± 1.1

[a] Captain 7096 operated a larger fishing vessel (10 m) than the other captains and fished exclusively in nearshore (0.0–4.8 km) and offshore (4.8–322.0 km) waters of the South Atlantic.

frequently reported species were Spanish mackerel *Scomberomorus maculatus* ($n = 881$; 45%), spotted seatrout *Cynoscion nebulosus* ($n = 204$; 10.4%), bluefish *Pomatomus saltatrix* ($n = 183$; 9.4%), red drum ($n = 163$; 8.3%), and kingfishes *Menticirrhus* spp. ($n = 150$; 7.7%). Collectively, these taxa accounted for 80.8% of the fish reported.

In addition to species identification and number caught, participants were asked to designate the disposition of the catch (kept or released) and were given the opportunity to report total length measurements in inches for any single observation. Clients kept 1,123 fish and released 834, and the percentages varied by species and participating captain. Of the finfish that were retained by participants, Spanish mackerel ($n = 611$), kingfishes ($n = 150$), spotted seatrout ($n = 131$), and bluefish ($n = 72$) made up 49% of the harvest. While popular inshore species like red drum and southern flounder *Paralichthys lethostigma* had high release rates (90% and 58%, respectively), several species or species groupings were not retained by any for-hire operation. Three of the six participants utilized the reporting system's ability to include total length measurements for a total of 13 fish.

System Performance

No detectable errors were observed in either the operation of the prepaid mobile phones or Twitter, the text message aggregating service used in this study. Because we were able to activate the phones, load minutes, and register the phones with the aggregator prior to delivering the phones to participants, pitfalls related to system registration were avoided.

Although we received a small percentage of fishing reports with detectable errors, all information submitted by participants using the RECTEXT syntax was usable for analysis. Because reports were first posted in raw code form on the aggregator website, we were able to review them for typing errors, assuming that all transmissions submitted were received. Of the 128 reports received, only five (3.9%) had detectable errors (i.e., data fields not separated by spaces, number of interactions placed before species codes, etc.). Considering that the 128 reports contained a total of 548 separate data fields (sections of code separated by spaces), 99.1% of the data submitted was usable when it was received without further action on our part. Four of the five errors observed were submitted by the two participants who had never before sent or received a text message.

In addition to the data entered manually by participants, time of submission was automatically recorded as part of each fishing report. As individuals were asked only to submit the report as soon as possible after the completion of their trip, we received reports at various times of day throughout the study (Figure 3). While most participants indicated that reports were submitted directly after trips or at latest, several hours after the trips, participants 7105 and 4338 for the most part did not submit individual trip reports. These individuals usually submitted reports in batches after several consecutive trips. When time of report submission was plotted against date for the entire study period and participants 7105 and 4338 were excluded, it was apparent that the majority of reports (76%) were submitted between 1200 and 2400 hours. As the majority of fishing trips were initiated in the morning hours, we did not expect to receive a large number of reports before noon.

Postdata Collection Survey

A poststudy survey completed by participants indicated that the fisheries reporting system was easy or relatively easy to use. All participants agreed that we provided sufficient training and instruction materials on system use. Prior to this study, all six participants indicated that they kept a personal paper logbook of their catch history for their own records; therefore, it was not difficult for them to compile the information necessary for each text message report. Individuals were also asked which method of reporting should be developed if mandatory reporting for the for-hire sector

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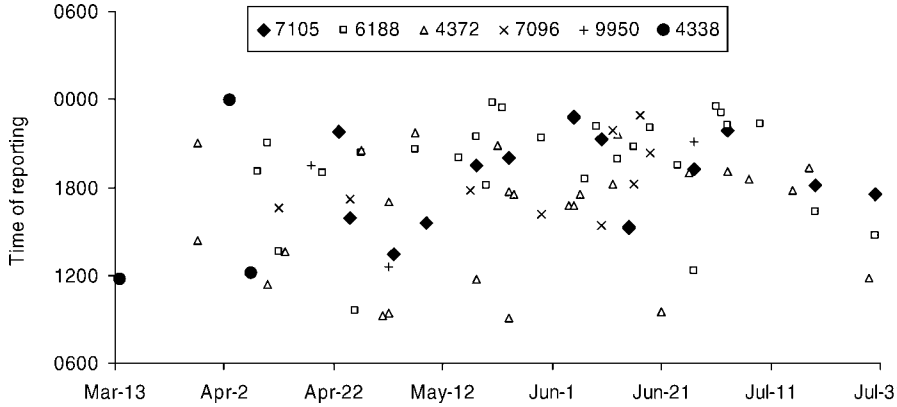


FIGURE 3.—Time of reporting plotted against date for six for-hire marine fishing captains that submitted angler effort and catch data via text messages (RECTEXT syntax).

is required in the future. Of the four participants who responded to the question, three indicated that some form of electronic data submission (i.e., mobile phone, website data entry, etc.) would be preferred over traditional methods, such as paper-based logbooks or trip-tickets.

Discussion

System Evaluation

The results of this study indicate that the text message based fisheries reporting system described here is capable of handling basic effort and catch information submitted directly from recreational anglers in the field and displaying that information in near real-time in a dedicated database. Although we chose to focus on marine recreational fisheries because of the relative lack of information available for many U.S. marine stocks (NOAA Fisheries 2008a), additional syntaxes could easily be developed for freshwater fisheries applications as well as for many other volunteer environmental monitoring programs (USEPA 1998; Savan et al. 2003). We were able accomplish our objectives in part by developing the compact syntax RECTEXT such that we could work within the limitations of the SMS infrastructure. Twitter provided not only a free text message aggregating service for this trial but also a portal by which we could review participants' fishing reports for errors in coding prior to transcription. Comments we received from participants indicate that this method of data submission and collection has potential and should be further evaluated.

Errors made by participants using the RECTEXT language were fewer than anticipated, considering that 34 reports (27%) were submitted by individuals who had never used text messaging prior to this study. As we were unable to find information on data entry error rates associated with other self-reporting programs, we can assume that errors might occur during transcription if paper forms are used (Gouveia et al. 2004) or during data entry through electronic methods. Using demographic information obtained from the preliminary survey, we determined that four of the five detectable errors in our study were unknowingly made by the two oldest participants (age range = 45–55+), who also happened to be the ones that had never before used text messaging. This is not surprising as other researchers have observed that middle-aged and older users were not as adept at text messaging as younger users (Kurniawan 2008; Soriano et al. 2006). Having anticipated this, we felt it was imperative to provide brief training sessions with individuals (if needed) prior to the start of data collection. Positive feedback from users indicated to us that the pocket reference guide and the time spent initially instructing participants on system use were beneficial and appreciated. While it is possible that additional errors, such as those related to species identification, also occurred during this study, we felt this was unlikely considering that professional captains submitted all the reports for this study.

Although reports submitted by participants were received by the data aggregator moments after submission, there was often considerable delay (up to 6 h) in the time it took to route some of these reports to our website for assimilation and viewing purposes. This delay probably occurred because at the time of this study, Twitter only had limited capacity to perform noncritical functions, such as RSS feeds, in addition to those required to perform basic services. As real-time display of fishing reports on our website was not required for our evaluation, we recommend that to truly take advantage of this reporting technique, a fee-based

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text message aggregating service should be used to provide actual real-time assimilation of self-reported data (Brown et al. 2007).

For this study, participants were neither informed of the data aggregation website nor given access to the website used to display the fishing reports. As a consequence, participants were not able to determine whether text messages successfully submitted from their phones were received by the system. As text messages are routed through mobile communication networks by using a store and forward mechanism (Brown et al. 2007), transmission of text messages to the intended receiver cannot be guaranteed. Although lost or failed transmissions rarely occur, the benefit of a text message based reporting system is that electronic "receipts" can be retrieved from originating phones, providing evidence of text message submission attempts in case validation is needed. For this study, participants were instructed to resubmit text message reports only if the message failed to send, and to our knowledge such failures did not occur. As we did not ask participants to keep an additional record of reports for validation purposes, we assumed that all text messages submitted were received by the data aggregator and displayed on our website. In future surveys, we suggest that participating anglers be able to browse their personal text message reports for the dual purpose of error identification and verification of any possible text message submission failure.

Text Messaging Compared with Existing Electronic Self-reporting Mechanisms

Paper logbooks, catch cards, and angler diaries have been the most popular types of recording device for angler-reported data in past surveys as these are inexpensive to manufacture, are easily customized, and can be used for small groups (Gartside et al. 1999; Campbell et al. 2003) or even statewide surveys (Bray and Schramm 2001). Despite their benefits, paper-based methods require significant time and resources to manage effectively (Cooke et al. 2000). Repeated handling of the data also reduces the time that administrators can spend interacting with and responding to the participants. In a review of 47 angler diary and voluntary logbook programs in Canada, Cooke et al. (2000) indicated that of the 70% of programs that failed, many did not establish adequate feedback mechanisms to respond to angler inquiries or improve the survey once initiated. While real-time data acquisition may not be necessary for all applications, the use of paper-based self-reporting methods all but eliminates this opportunity.

Use of a web-based portal allows registered anglers to log in to a website and fill out customizable forms detailing trip-level fishing activity, resulting in timely assimilation of data that are usable by fisheries managers. Established agency-based programs along the Atlantic coast, such as the Maryland Volunteer Angler Survey (MDDNR 2009), have been able to provide year-to-year comparisons between angler-reported data and MRFSS data for a variety of species, including recreationally important striped bass *Morone saxatilis* and summer flounder *Paralichthys dentatus*. The program has inspired other state fisheries agencies in Maine, New Hampshire, and New Jersey to adopt similar web-based reporting programs for anglers. While this reporting approach can reduce the cost of survey administration and improve angler confidence in MRFSS data, the drawbacks of this technique are that (1) anglers must have access to the internet and (2) information is usually submitted after the fishing event, subjecting the data to potential recall and prestige biases (Pollock et al. 1994; Connelly et al. 2000). The web-based reporting method also makes it problematic to validate report contents unless the database can be configured to receive reports submitted electronically from the field by using a network or internet-enabled device.

Dedicated electronic logbooks provide yet another method to submit and assimilate self-reported data. These applications allow for detailed data entry, on-site storage, and report submission at-sea to managers primarily through periodic internet connections with satellite or mobile communication networks. Example programs, such as Catchlog (www.Catchlog.com) and Olfish (www.olfish.com), both used primarily in commercial fishing operations, are operated from laptop computers on the vessel. Third-party applications like these often bundle additional features to benefit the fisherman in improving operations and making informed, timely marketing decisions. In cooperation with interagency project partners (Alaska Department of Fish and Game and International Pacific Halibut Commission), NOAA Fisheries has developed its own Interagency Electronic Reporting System for select commercial fisheries in the Pacific Northwest (NOAA Fisheries 2009). The obvious disadvantages of electronic logbooks include the requirement for a computer and communication terminal onboard the vessel as well as any required costs for the application itself (if third party) and associated subscription or annual maintenance fees. If the primary objective is to collect basic, single-trip-level effort and catch information from recreational anglers at the completion of trips, a mobile phone-based reporting method would be much less costly and would be accessible to more users than applications requiring internet- or satellite-based communications (CTIA–The Wireless Association

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2008; Horrigan 2008). In addition, a text message based reporting program as described in this study is highly scalable and customizable due to the small data "footprint" of SMS compared with voice calls (Brown et al. 2007) and the use of open-source applications and off-the-shelf components.

Despite the advantages of using mobile phones for self-reporting, there are currently drawbacks to this electronic approach. For example, SMS is limited to a maximum of 160 characters and does not support more data-rich file types, such as photos and videos (Brown et al. 2007). Therefore, the technical limitations of SMS might make it programmatically difficult to report extremely detailed information from anglers. In comparison with using a full-sized keyboard to submit data via a website application, usability of SMS is arguably dependent on the type or style of phone used (Balackrishnan et al. 2005). The prepaid, "candy bar" phones used in this study were small and required that participants toggle through keys to select the appropriate character. Use of a compact syntax like that developed for this study on mobile phones with full or slide-out keyboards or phones with predictive text capabilities (MacKensie and Soukeroff 2002) would probably minimize reporting errors and decrease time required to compose reports. Implementation of a mobile phone reporting system would also require that communication networks exist in a survey area. Because the number of subscribers and geographic reach of mobile communication networks have expanded at a rapid rate over the last several years (CTIA–The Wireless Association 2008), this is likely to be an insignificant issue in the years to come.

The real-time nature, on-site submission capability, and growing acceptance of this universal, low-cost communication method are arguably the most compelling aspects of this approach when compared with existing electronic self-reporting methods. As text message reports are received momentarily after submission by an angler, it is possible for administrators to simultaneously view this data on a website from either an internet-accessible mobile phone (i.e., smartphone) or a portable computer while on-site. Conveniently, this method would only require administrators to have smartphones or computers for viewing reports, whereas individual anglers would only need standard mobile phones to submit reports.

Consideration should also be given to the fact that the reliance on mobile communication devices and the resulting technology are growing at a rapid rate in this country. Mobile phone subscriptions in the United States have dramatically increased in recent years from 194.4 million in June 2005 to 262.7 million in June 2008, reaching a penetration rate (percent of total population with a mobile phone subscription) of 84.7% (CITA–The Wireless Association 2008). During that same time period, the number of text messages sent increased from 57.2×10^9 to 600.5×10^9. In a recent survey conducted by the Pew Internet and American Life Project (Horrigan 2008), over 2,000 individuals were asked how hard it would be to give up a specific technology; respondents indicated that the mobile phone would be the hardest to do without, followed by the internet, television, and landline telephone. The concept that a cost-effective, easy-to-use, portable, real-time reporting system does not exist for the individual angler is no longer an issue. The mobile phone and its ability to communicate with data networks clearly indicate that it will remain a staple of American households for the foreseeable future.

Suggestions for Future Evaluation and Implementation

Any self-reporting method is likely to have a higher acceptance rate by all end users if the contents of reports can be easily validated (Pollock et al. 1994). As the primary objective of our study was to develop and evaluate the actual data collection process, future studies should consider incorporating on-site intercept surveys to validate report contents. The method described here is capable of assembling small amounts of information from a large number of anglers during a short period of time. We suggest that further evaluation be focused on fishing practices or special events that should be monitored but that for various reasons have been difficult to characterize with traditional survey methods. In addition to the for-hire reporting method described here as well as potential for personalized electronic diaries for individual anglers, the text message approach may provide a mechanism to collect verifiable effort and catch data from anglers participating in organized clubs, associations, and fishing tournaments.

Despite the large number of anglers that participate in marine fishing tournaments throughout the country (Falk et al. 1989; Oh et al. 2007), characterization of the effort and catch data associated with these events is usually avoided by fisheries managers simply because of the inherent biases and logistical difficulties associated with sampling these types of events (Essig and Holliday 1991). In a typical tournament setting, a large number of anglers expend high amounts of fishing effort over a very short time period, often targeting larger fish than would be targeted during normal fishing activities (Loomis and Ditton 1987). Despite the difficulty in quantifying tournament fishing impacts on fisheries resources, the number of tournaments appears to be increasing nationally and the effort and catch associated with these events could be

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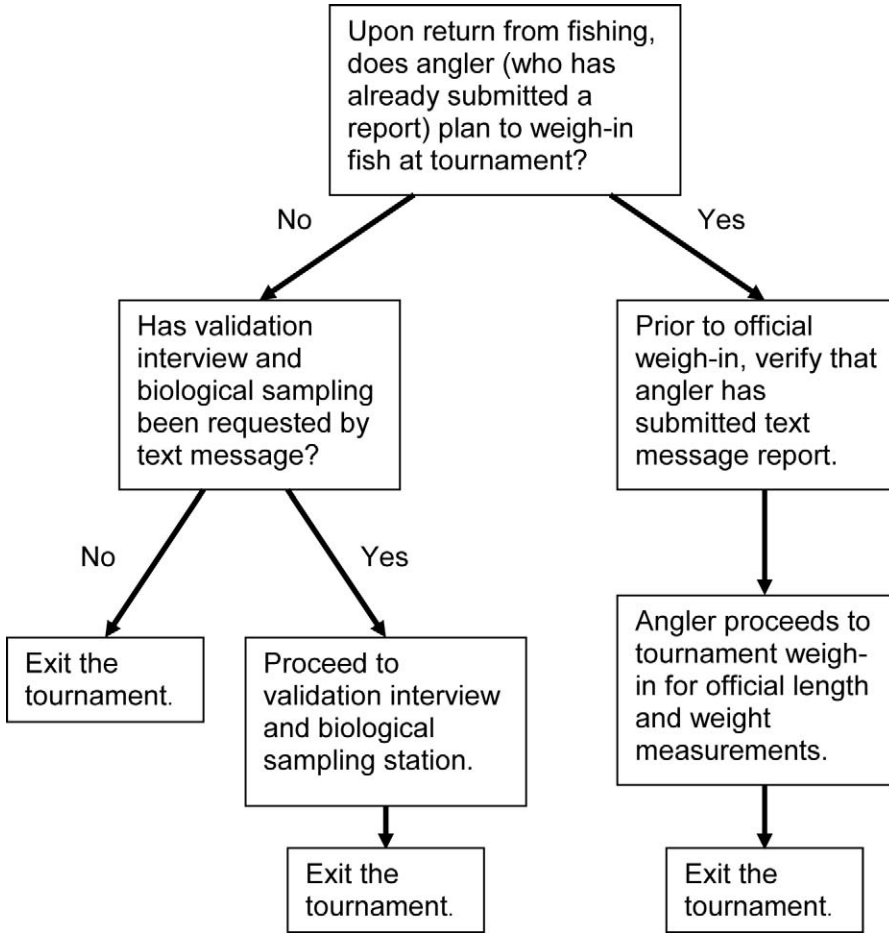


FIGURE 4.—Suggested protocol for sampling tournament anglers who would submit effort and catch information via the text message based reporting method.

significant in relation to the total recreational harvest for many species. Where traditional intercept methods applied in a tournament setting would likely lead only to data that are of limited use for fisheries management purposes (Pollock et al. 1994), simultaneous, real-time reporting by all registered anglers may enable managers to track general effort and catch statistics for these events.

A tournament setting would allow the opportunity for a sampling protocol to be established to validate angler's reports. As it may be logistically difficult to verify all anglers' text message reports for content, a design could be developed such that a percentage of tournament anglers is requested at random to complete follow-up exit surveys regardless of fishing success (Figure 4). An automated text message notification sent to anglers immediately after report submission (via the aggregating service) would expedite the postfishing intercept process in often hectic tournament sampling situations. By requesting that anglers submit reports as soon as possible after completion of fishing activity but before the tournament deadline, administrators would have time to conduct staggered exit interviews with anglers. At exit interviews, self-reported information, such as species identification, length, and weight estimates, could be validated on site by survey administrators. In the unlikely event that the internet database does not receive the text message report, each angler would have an electronic receipt available on the mobile phone to provide proof of attempted transmission during the designated reporting period. Such a design would allow survey administrators to collect and verify content submitted by successful anglers (those submitting fish to the tournament) and by anglers that voluntarily exit the tournament after fishing for any variety of reasons.

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This format of "required" self-reporting, albeit with paper catch cards and shoreside surveyors, has been used successfully in bass tournaments (Quertermus 1991) and in a national park where fishing licenses were surrendered in exchange for mandatory trip reports (Larson et al. 1986). Data collected over several years could allow fisheries managers the opportunity to characterize the fishing practices of tournament anglers. If successful, data collected may provide an additional scientific index to facilitate the development of future management actions. One distinct advantage of such a customizable data collection program is that anglers would have an opportunity to contribute effort and catch data directly to management agencies in a format that would ultimately be usable by anglers, fishery managers, and tournament organizers.

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References

Balackrishnan, V., P. H. P. Yeow, and D. C. L. Ngo. 2005. An investigation on the ergonomic problems of using mobile phones to send SMS. Pages 195–199 *in* P. D. McCabe and P. T. McCabe, editors. Contemporary ergonomics. Taylor and Francis, London.

Bray, G. S., and H. L. Schramm, Jr. 2001. Evaluations of a statewide volunteer angler diary program for use as a fishery assessment tool. North American Journal of Fisheries Management 21:606–615.

Brown, J., B. Shipman, and R. Vetter. 2007. SMS: the short message service. Computer 40(12):106–110.

Campbell, R. A., J. G. Pepperall, and T. L. O. Davis. 2003. Use of charter boat data to infer the annual availability of black marlin, *Makaira indica*, to the recreational fishery off Cairns, Australia. Marine and Freshwater Research 54:447–457.

Coleman, F. C., W. F. Figueira, J. S. Ueland, and L. B. Crowder. 2004. The impact of United States recreational fisheries on marine fish populations. Science 305:1958–1960.

Connelly, N. A., T. L. Brown, and B. A. Knuth. 2000. Assessing the relative importance of recall bias and nonresponse bias and adjusting for those biases in statewide angler surveys. Human Dimensions of Wildlife 5:19–29.

Cooke, S. J., W. I. Dunlop, D. Macclennan, and G. Power. 2000. Applications and characteristics of angler diary programmes in Ontario, Canada. Fisheries Management and Ecology 7:473–487.

Cronin, M. A., and B. J. McConnell. 2008. SMS seal: a new technique to measure haul-out behavior in marine vertebrates. Journal of Experimental Marine Biology and Ecology 362:43–48.

CTIA–The Wireless Association. 2008. Wireless quick facts. Available: www.ctia.org/media/industry_info/index.cfm/AID/10323. (October 2008).

Ebbers, M. A. 1987. Vital statistics of a largemouth bass population in Minnesota from electrofishing and angler-supported data. North American Journal of Fisheries Management 7:252–259.

Essig, R. J., and M. C. Holliday. 1991. Development of a recreational fishing survey: the Marine Recreational Fisheries Statistics Survey case study. Pages 245–254 *in* D. Guthrie, J. M. Hoenig, M. Holliday, C. M. Jones, M. J. Mills, S. A. Moberly, K. H. Pollock, and D. R. Talhelm, editors. Creel and angler surveys in fisheries management. American Fisheries Society, Symposium 12, Bethesda, Maryland.

Falk, J. M., A. R. Graefe, and R. B. Ditton. 1989. Patterns of participation and motivation among saltwater tournament anglers. Fisheries 14(4):10–16.

Gartside, D. F., B. Harrsion, and B. L. Ryan. 1999. An evaluation of the use of fishing club records in the management of marine fisheries. Fisheries Research 41:47–61.

Gouveia, C., A. Fonseca, A. Câmara, and F. Ferreira. 2004. Promoting the use of environmental data collected by concerned citizens through information and communication technologies. Journal of Environmental Management 71:135–154.

Horrigan, J. B. 2008. Mobile access to data and information: March 2008. Pew Internet and American Life Project. Available: www.pewinternet.org. (October 2008).

Jensen, R. 2007. The digital provide: information (technology), market performance, and welfare in the South Indian fisheries sector. Quarterly Journal of Economics 122:879–924.

Johnson, T. R., and W. L. T. van Densen. 2007. Benefits and organization of cooperative research for fisheries management. ICES Journal of Marine Science 64:834–840.

Kurniawan, S. 2008. Older people and mobile phones: a multi-method-investigation. International Journal of Human-Computer Studies 66:889–901.

Larson, C. L., S. E. Moore, and D. C. Lee. 1986. Angling and electrofishing for removing nonnative rainbow trout from a stream in a national park. North American Journal of Fisheries Management 6:580–585.

Loftus, A. J., J. Waldon, V. Fay, K. Davy, and J. Lucy. 2000. Overview of angler based tagging programs and management issues. Fisheries 25(4):8–13.

Loomis, D. K., and R. B. Ditton. 1987. Analysis of motive and participation differences between saltwater sport and tournament fishermen. North American Journal of Fisheries Management 7:482–487.

Lucy, J., and K. Davy. 2000. Benefits of angler-assisted tag and release programs. Fisheries 25(4):18–22.

MacKensie, I. S., and R. W. Soukeroff. 2002. Text entry for mobile computing: Models and methods, theory and practice. Human Computer Interaction 17:147–198.

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McCluskey, S. M., and R. L. Lewison. 2008. Quantifying fishing effort: a synthesis of current methods and their applications. Fish and Fisheries Series 9:188–200.

McConnell, B., R. Beaton, E. Bryant, C. Hunter, P. Lovell, and A. Hall. 2004. Phoning home: a new GSM mobile phone telemetry system to collect mark-recapture data. Marine Mammal Science 20:274–283.

MDDNR (Maryland Department of Natural Resources). 2009. Maryland Volunteer Angler Summer Flounder Survey. Available: www.dnr.state.md.us/fisheries/survey/sfsurveyintro.html. (March 2009).

Mosindy, T. E., and M. J. Duffy. 2007. The use of angler diary surveys to evaluate long-term changes in muskellunge populations on Lake of the Woods, Ontario. Environmental Biology of Fishes 79:71–83.

NOAA Fisheries (National Oceanic and Atmospheric Administration Fisheries Service). 2008a. Marine Recreational Information Program: program overview. Available: www.st.nmfs.noaa.gov/mrip/aboutus/index.html. (October 2008).

NOAA Fisheries. 2008b. Fisheries of the United States 2007. Available: www.st.nmfs.noaa.gov/st1/fus/fus07/fus_2007.pdf. (April 2008).

NOAA Fisheries. 2009. Interagency Electronic Reporting System (IERS): Elandings overview. Available: https://elandings.alaska.gov. (March 2009).

NRC (National Research Council). 2006. Review of Recreational Fisheries Survey Methods. National Academy Press, Washington, D.C.

Oh, C., R. B. Ditton, and R. Riechers. 2007. Understanding anglers' preferences for fishing tournament characteristics and policies. Environmental Management 40:123–133.

Pollock, K. H., C. M. Jones, and T. L. Brown. 1994. Angler survey methods and their applications in fisheries management. American Fisheries Society, Special Publication 25, Bethesda, Maryland.

Quertermus, C. J. 1991. Use of bass club tournament results to evaluate relative abundance and fishing quality. Pages 515–519 *in* D. Guthrie, J. M. Hoenig, M. Holliday, C. M. Jones, M. J. Mills, S. A. Moberly, K. H. Pollock, and D. R. Talhelm, editors. Creel and angler surveys in fisheries management. American Fisheries Society, Symposium 12, Bethesda, Maryland.

Savan, B., A. J. Morgan, and P. Gore. 2003. Volunteer environmental monitoring and the role of universities: the case of Citizens' Environment Watch. Environmental Management 31:561–568.

Soriano, C., G. K. Raikundalia, and J. Szajman. 2006. Middle-aged users' experience of short message service. Pages 109–112 *in* W. Piekarski, editor. The proceedings of the Seventeenth Australasian Database Conference (AUIC2006), Hobart, Australia. Conference in Research and Practice in Information Technology Series, volume 50. Australian Computer Society, New South Wales.

Starr, P. J., and M. Vignaux. 1997. Comparison of data from voluntary logbook and research catch-sampling programmes in the New Zealand lobster fishery. Marine and Freshwater Research 48:1075–1080.

USEPA (U.S. Environmental Protection Agency). 1998. National directory of volunteer environmental monitoring programs. Available: www.epa.gov/OWOW/monitoring/dir.html. (March 2009).

Wikipedia. 2009a. Twitter. Wikipedia: the free encyclopedia. Available: http://en.wikipedia.org/w/index.php?title=Twitter&oldid=278365030. (March 2009).

Wikipedia. 2009b. SMS. Wikipedia: the free encyclopedia. Available: http://en.wikipedia.org/w/index.php?title=SMS&oldid=279017068. (March 2009).

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