Northeast Fisheries Science Center Reference Document 03-07

Implementation of Electronic Logbook Reporting in a Squid Bottom Trawl Study Fleet during 2002

by

Lisa C. Hendrickson, David A. Hiltz,
Holly M. McBride, Barbara M. North,
and Joan E. Palmer

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ABSTRACT

An electronic logbook reporting system was implemented in a study fleet of commercial vessels that fished for Northern shortfin squid (*Illex illecebrosus*) during June-September 2002. Project objectives included the design of an electronic logbook reporting system that would fulfill the existing regulatory requirements for logbook reporting and that would improve the resolution, quality and timeliness of fishery data for stock assessments. The data collection process involved at-sea and web-based components. Catch, effort, depth, water temperature and location data were collected in real-time by vessel operators, on a tow-by-tow basis, through the execution of two macros. Data contained in the two macros were transmitted via e-mail to the Northeast Fisheries Science Center following each tow and at the end of each day by a satellite service provider. A Perl script was written to extract data from the e-mails upon their receipt and to load the data into a relational database. Upon completion of a trip, vessel operators logged onto secure, personal web sites that were password-protected and then verified the data entered at sea, assigned tows to specific trips and entered supplemental data required to meet existing logbook reporting requirements. The web site included an interactive mapping program that allowed vessel operators to visualize the spatial distribution of their data and to query their data to produce hardcopy logbook reports. The auditing process relied primarily on error correction by vessel operators during the website data review and entry process, but error checking was also included at the data entry and database processing levels. Squid length and weight data were collected by staff from squid processing plants and subsequently entered into an Oracle database that included links to the tow and catch databases. The study demonstrated that electronic logbook reporting offers an efficient, cost-effective means of collecting accurate, high resolution fisheries and oceanographic data that is useful to fishermen, stock assessment scientists and fisheries managers.

INTRODUCTION

The Northeast Fisheries Science Center (NEFSC), in cooperation with a study fleet of commercial vessels that participate in the Northern shortfin squid (*Illex illecebrosus*) fishery conducted an electronic logbook reporting study during June-September 2002. The *Illex* fishing season generally occurs during June-October and vessels complete approximately three to four tows per day during trips ranging from several days to two weeks (NEFSC 1999). Submittal of hardcopy logbooks, Vessel Trip Reports (VTR), has been a regulatory requirement of the *Illex* fishery since January 1, 1997 (MAFMC 1996). Logbooks containing data on catch, effort and fishing location must be submitted. A trip is defined as the time between leaving port to fish and returning to port to land the catch. The spatial and temporal resolution of the VTR data is coarse and consists of a single fishing location per subtrip. Separate logbook forms must be submitted for each subtrip, represented by a change in Statistical Reporting Area (Figure 1), gear type, or net mesh size. Fishermen are required to mail their logbooks, on a monthly basis, to a central location where the data are entered into a relational database (Oracle) and audited. Data processing activities and delays in the submittal of logbooks often result in time lags of several months before these data are available to end users.

NEFSC scientists and a portion of the *Illex* fleet have been conducting cooperative research studies since 1999, involving the collection of tow-based fisheries data on hardcopy logbook forms. Electronic reporting of fisheries data was the next logical step towards real-time data collection for possible use in conducting in-season stock assessments of *Illex*, which is an annual species.

Project Objectives

Implementation of an electronic logbook system in the *Illex* fishery was envisaged to improve the efficiency and consistency of data collection and processing and enhance data quality and resolution. Hardcopy data collection is labor-intensive for fishermen and data processing of hardcopy data is labor-intensive for database managers. As well, interpretation of handwritten data introduces potential database error.

The project objectives of the study included the design of an electronic logbook reporting system that would fulfill the existing regulatory requirements for reporting by harvesters in the *Illex* fishery and which would improve the resolution, quality and timeliness of data available for stock assessments. The electronic logbook reporting system was developed to meet the following criteria:

(1) Improve the accuracy and spatial and temporal resolution of VTR data via the collection of electronic, real-time, tow-based fisheries data**.**

(2) Provide a secure, web-based system to collect additional data necessary to meet VTR legal reporting requirements and for vessel operators to enter, edit and confirm their personal logbook data**.**

(3) Sea-based and web-based data collection systems must be efficient, user-friendly and cost-effective for vessel operators**.**

(4) Provide vessel operators with additional incentives for utilizing an electronic logbook system, such as useful reports and visualizations of their personal fisheries data via secure web sites**.**

MATERIALS AND METHODS

The data collection process consisted of sea-based and web-based components. Error checking occurred during data entry and data processing. Auditing was primarily based on information provided by vessel operators during the web site data collection and verification process. The data flow process is presented in Figure 2.

Real-time Data Collection at Sea

Tow-based fisheries data were collected at sea in real time. At-sea data collection required a GPS satellite service provider (SSP), a marine-quality transceiver/antenna, and hardware with an e-mail capability. A single SSP, which operated in conjunction with proprietary e-mail messaging units, was utilized because most study fleet vessels already possessed this capability. Data collection macros designed by the NEFSC were programmed and uploaded to the vessels by the SSP. Fishermen entered data into two types of macros, a tow macro and a catch macro. Data were transmitted in real-time to the SSP and then routed to the NEFSC via e-mails.

Study participants were provided with written protocols describing the macro data entry process but received no formal training. The data entry protocol required execution of a tow macro (Table 1) at the start and end of each tow, designated as winch lock and winch re-engage, respectively. Execution of the tow macro automatically generated date, time and location (latitude and longitude) data, as well as a unique vessel identifier (the e-mail messaging unit number). Limited data entry was necessary and included: entering a "B" or "E" to designate begin or end of tow, tow number, depth, water temperatures and a description of any gear problems. Tows were numbered sequentially throughout a trip. If for any reason, the tow macro was not executed at the beginning and end of a tow, Section 2 of the macro allowed for manual entry of the tow number, date, time and location at the start and end of a tow.

The protocol required execution of a catch macro (Table 2) following the last tow of each day, but prior to midnight, and data entry included the weight of the kept and discarded fractions of the catch listed by tow and species code. In the event that the catch macro was not e-mailed on the date that the catches were obtained, the macro required manual entry of the catch date for each tow, along with the other required data fields in the catch macro.

Database Creation

A Perl script was written to: (a) monitor the receipt of e-mails from the SSP; (b) automatically extract data from the e-mails; and (c) load the raw data into two Oracle tables (a haul table and a catch table). The same script was used to archive the e-mails. The haul table contained two records per tow, designated by "B" and "E", for begin and end of tow, respectively. The catch table was comprised of one or more species records per tow. The raw data in the two Oracle tables were archived in the form that they were received.

A second set of catch and haul tables was created from the raw data to serve as "working" tables to be updated using information entered or confirmed by vessel operators via secure, vessel-specific web sites. The haul table was created by merging begin and end of tow records from the raw data tables to create one record per tow. Several additional data fields were also created and populated. Statistical Areas were assigned to each tow based on an algorithm that used the vessel position recorded by the satellite at the start of the tow. Fishing effort (i.e., the number of hours fished) was computed as the difference between the time at the end and beginning of each tow.

The catch and haul tables were updated based on vessel operator input submitted to the web site. Additional tables were also created to summarize the haul and catch data in sub trip form. The Oracle database models are presented in Appendices 1-3.

The electronic logbook database was also linked to a biological database that contained squid dorsal mantle length and body weight data collected by staff from squid processing plants. The biological database was linked to the haul and catch databases via a unique vessel identifier, tow date and tow number, so that biological sampling locations could be determined.

Web Site Data Collection and Testing

Secure, password-protected web pages were established for each study participant and the web interface program was designed to be accessible through either Netscape or Microsoft Internet Explorer. The web server consisted of a Red Hat Linux operating system, Apache WebServer, Oracle9i relational database, and MapServe interactive geographical mapping software. The server was positioned in the DMZ (demilitarized zone) of the NEFSC firewall and Oracle tables containing raw data from the catch and tow macros resided inside the firewall on a Sun Solaris server running Oracle 8i (Figure 3). Perl scripts using DBI (Data Base Interface, a standard database interface for Perl) were used to extract data from the e-mails, insert data into raw tables, merge records, check for errors, and move data across the firewall. Web pages were programmed using Perl, DBI and CGI (Common Gateway Interface, an interface between the web server and operating system), and JavaScript. Several logs and security checks were updated thoughout the data collection process.

The web site was designed to minimize data entry time through the use of pull-down menus, check boxes and an option that allowed the user to establish vessel-specific default values for fields that remain consistent between trips. On-line help buttons and bold-faced designations of mandatory data entry fields were added to increase user-friendliness. The web site was designed to lead the user through a logical sequence of steps to generate tow-based data in a format that resembles the current Vessel Trip Reports**.**

Four options were available to the user from the home page of the Commercial Study Fleet Web Site (Figure 4). The options included: (1) verifying and entering fishery data; (2) interactive mapping of personal fisheries data; (3) creation of logbook data summary reports; and (4) creation or modification of default settings for logbook fields that remain consistent between trips (establishing vessel default values).

The entry of vessel default values (Figure 5) was optional, but because this reduced data entry time it was recommended as the first step upon entering the web site. Thereafter, the user began the process of assigning tows to a specific trip, or editing an existing trip, by selecting the main menu option to "Verify and Enter Fishery Data" (Figure 6). Tows conducted on dates that fell between the entries "Date Sailed" and "Date Landed1" were listed on a subsequent page, with unpaired begin or end of tow records listed within a shaded box located at the bottom of the screen (Figure 7). The user has to edit or delete unpaired haul records (Figure 8) to advance to web pages pertaining to the review and editing of the catch data associated with each tow of the trip (Figure 9). Next, the user enters gear data, if the vessel default settings page was not previously used to enter this information automatically, and then designates the hauls to which the gear data apply (Figure 10). The user is subsequently prompted to partition the amount, by species, of the total trip landings sold to each dealer (Figure 11), thereby producing a landings summary (Figure 12). A final product of the web site is a "VTR Summary Page" that reorganizes the summarized trip data into a format similar to a VTR logbook form that can be printed (Figures 13-15). The vessel operator selects the "confirm" button on this page to finalize the editing process and to certify that data submitted through the web site are complete and correct. Selection of the "confirm" button implies that the data are no longer available for editing.

A second option available from the main menu of the web site involved interactive mapping and database querying. This program allowed fishermen to visualize the spatial distribution of their personal data (i.e. catch per unit of effort), for any range of tow dates, and to query the database to display information associated with tows that are selected interactively (Figure 16).

A third main menu option allowed the user to create summarized data reports. This feature allowed the choice of three report types (species, trip or cpue) summarized by date range, month, quarter or year (Figures 17 and 18).

The web site was tested in-house and recommended modifications were completed prior to website access by the study participants. At the end of the *Illex* fishing season, the web

site development team met to obtain participant feedback regarding web site design and use. Subsequent improvements to the web site were made based on this feedback.

RESULTS AND CONCLUSIONS

Study fleet participation was lower than expected due to a reduction in the number of vessels engaged in the 2002 *Illex* fishery. However, the project objectives were met and the proposed products were produced, tested and improved upon based on participant feedback.

Data Collection Costs

The macro transmission cost paid by each vessel operator was approximately $1.00 per tow (which included 50 cents per e-mail transmittal and 0.004 cents per character entered in each macro). The greatest portion of the total cost associated with at-sea data collection, [i.e., the e-mail messaging unit (approximately $6,000) and satellite connection fees ($70 per month)], was subsumed in the existing operating costs of most study fleet participants. At-sea data collection costs borne by the NEFSC included SSP macro programming fees ($90 per hour) and fees for macro uploads to the vessels ($65 per macro upload). There was no data auditing cost.

The study demonstrated that electronic logbook reporting offers an efficient, cost-effective means of collecting accurate, high resolution fisheries and oceanographic data useful to fishermen, stock assessment scientists and fisheries managers. The methods developed in the subject study were designed for implementation in any fishery but training sessions in sea-based and web-based data collection methods would be beneficial to fishermen, in addition to dissemination of written protocols.

Recommendations for Improvements

During 2003, additional testing of the sea-based and web-based data collection systems is recommended to gain feedback from a larger number of vessel operators utilizing additional types of fishing gear.

The macros developed for this pilot project could be redesigned for generic use onboard any vessel that has a satellite service provider and e-mail capabilities. Many vessels have onboard computers but use different satellite service providers. A more versatile, cost-effective means of capturing and transmitting data at sea would consist of macros that are served on the Internet, from a secure web site, and accessed via shipboard computers.

In addition, the following recommendations are suggested for improving future electronic logbook reporting studies:

1. The creation of a third macro, a trip macro, would allow tows to be combined into trips prior to web site auditing. The trip macro could be e-mailed when the vessel is heading into port, or thereafter, and include the following fields:

date sailed, time sailed, date landed and time landed. Manual entry of the trip data is preferred over simply sending the macro, which could be easily forgotten, to produce a date and time stamp.

2. Data entry at sea could be minimized further by connecting a vessel's GPS and gear-mounted sensors to a shipboard computer for real-time recording of output from theses devices.

3. Training of vessel operators regarding use of the website.

The web-based, fisheries data collection program developed herein could be expanded to include port sample data and dealer purchase data which could then be linked to the electronic logbook database.

ACKNOWLEDGEMENTS

This project would not have been possible without the participation of fishermen from the *Illex* study fleet who volunteered to test the data collection program at sea and whose feedback resulted in an improved product. We are especially grateful to Captain Jimmy Ruhle (F/V *Darana R*) for his recommendations as a member of the web site development team.

REFERENCES

Mid-Atlantic Fishery Management Council. 1996. Amendment #5 to the Fishery Management Plan for the Atlantic mackerel, squid, and butterfish fisheries. 168 p.

Northeast Fisheries Science Center. 1999. Report of the 29th Northeast Regional Stock Assessment Workshop (29th SAW): Stock Assessment Review Committee (SARC) Consensus Summary of Assessments. Northeast Fish. Sci. Cent. Ref. Doc. 99-14; 347 p.

Table 1. Tow macro sent via e-mail to the NEFSC, at the beginning and end of each tow, from *Illex* fishing vessels participating in an electronic logbook reporting study during 2002.

SECTION 1	**BEGIN Example**	**END Example**
Enter today's tow number:	**1**	**1**
Begin or End tow? (Enter "B" or "E"):	**B**	**E**
Enter depth (fath):	**120**	**122**
Enter surface temp (F):	**65**	**66**
Enter bottom temp (F):	**57**	**59**

Describe any gear problems : _____

SECTION 2

Enter ALL of the following fields IF you forgot to send a Begin/End tow message:

Tow date: _ _/_ _/_ _

Tow Begin Time: _ _ _ _ (24HR GMT)

Tow End Time: _ _ _ _ (24HR GMT)

Loran Begin Tow: _ _ _ _ _ _ _ _ _ _ _ _
TD1 TD2

Loran End Tow: _ _ _ _ _ _ _ _ _ _ _ _
TD1 TD2

Describe any gear problems, refer to tow number :

_____

Table 2. Catch macro sent daily to the NEFSC, via e-mail, from *Illex* fishing vessels participating in an electronic logbook reporting study during 2002.

Enter today's target and bycatch species:

Tow Number	VTR Species Code	Pounds Kept	Pounds Discarded
1	**SQI**	**10500**	**0**
1	**SQL**	**5000**	**0**
2	**SQI**	**15000**	**500**
2	**JDORY**	**0**	**50**

Enter catch date if not today: _ _/_ _/_ _

Figure 1. Statistical Areas used to report fisheries catch and effort data in Vessel Trip Reports.

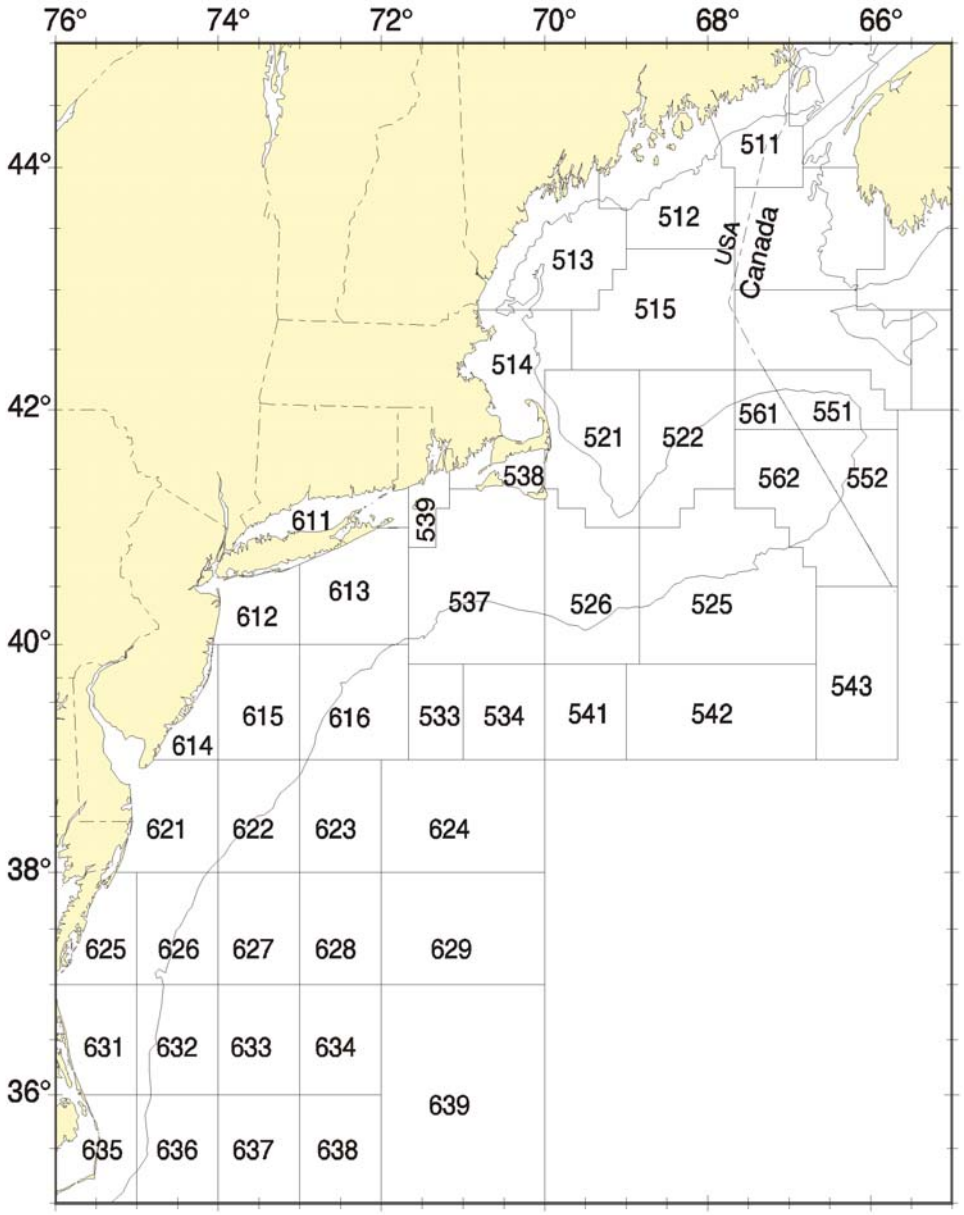


Figure 2. Data flow process for electronic logbook reporting by the *Illex* study fleet during 2002.

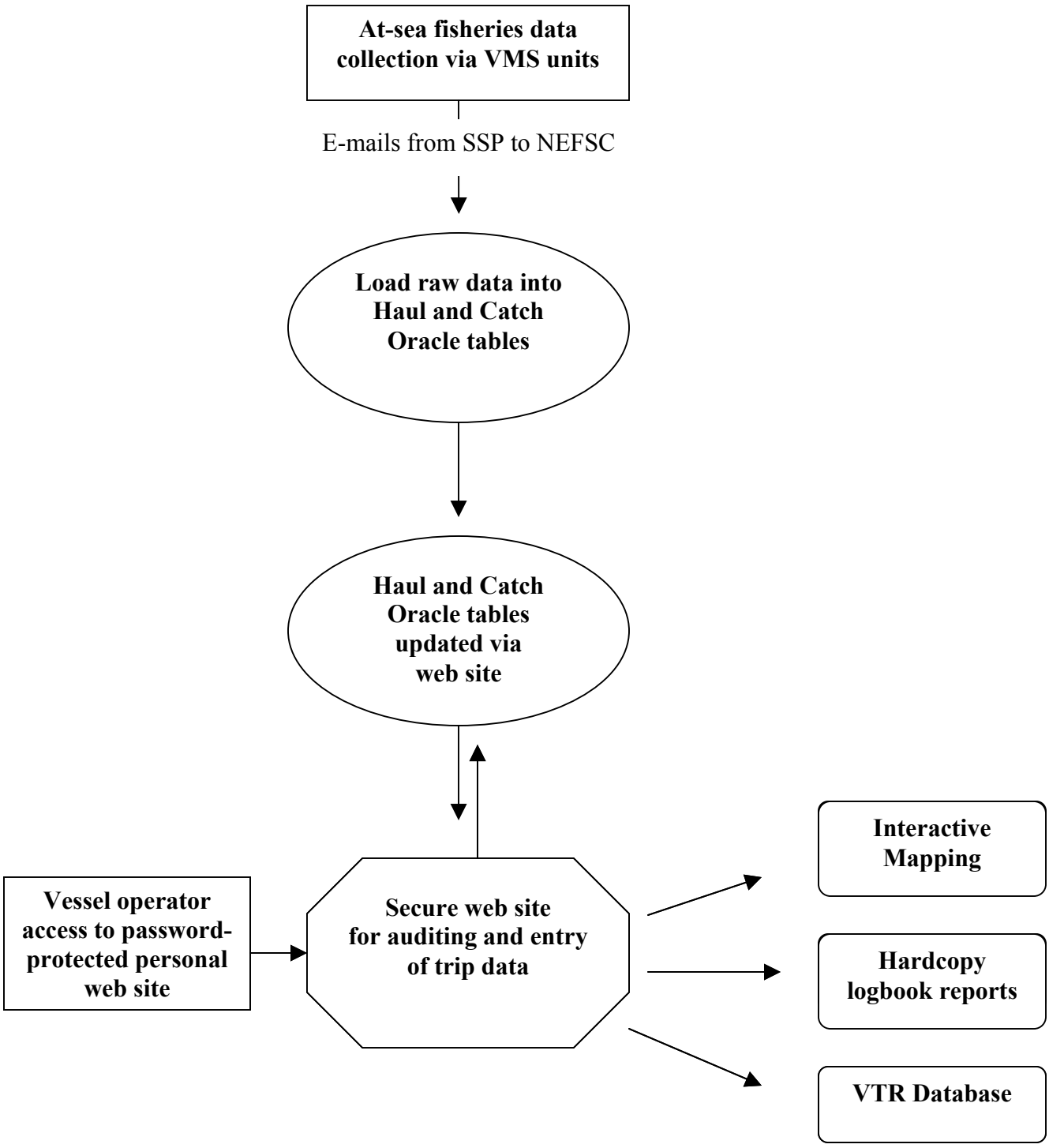


Figure 3. Hardware model for electronic logbook reporting by the *Illex* study fleet during 2002.

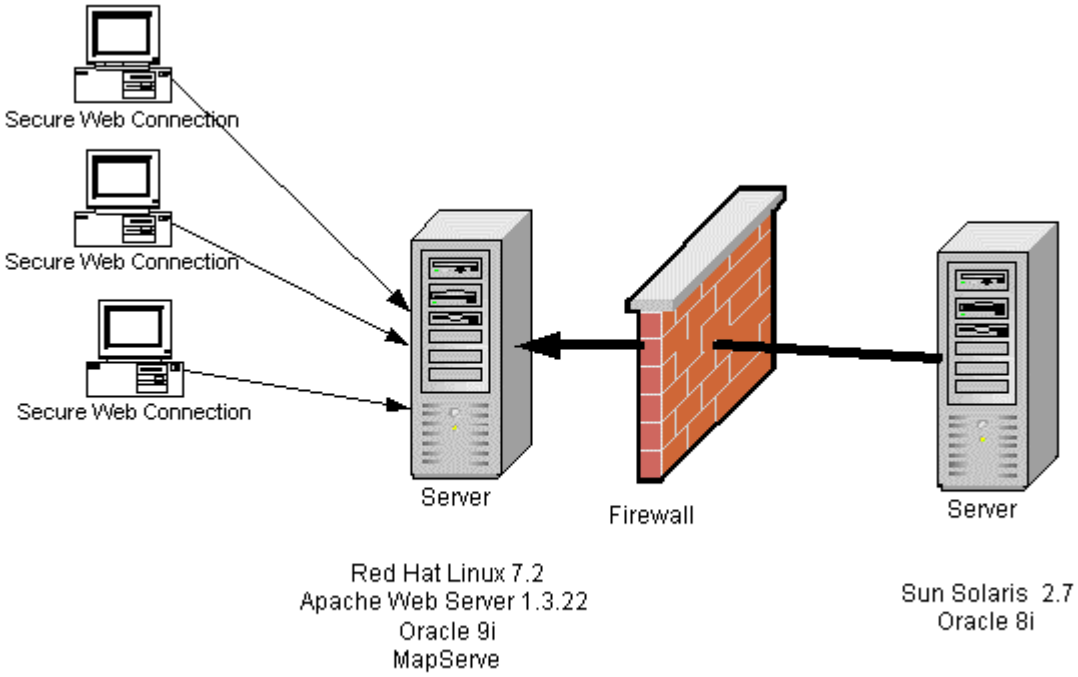


Figure 4. Main menu options available from the homepage of the Commercial Study Fleet Web Site for electronic logbook reporting.

Figure 5. Web page that allows the option of setting or editing default values for fields that remain consistent between trips. Note the pull-down menu, designated as a "?" button, which allows the user to select data to be entered into the "Gear Type" field.

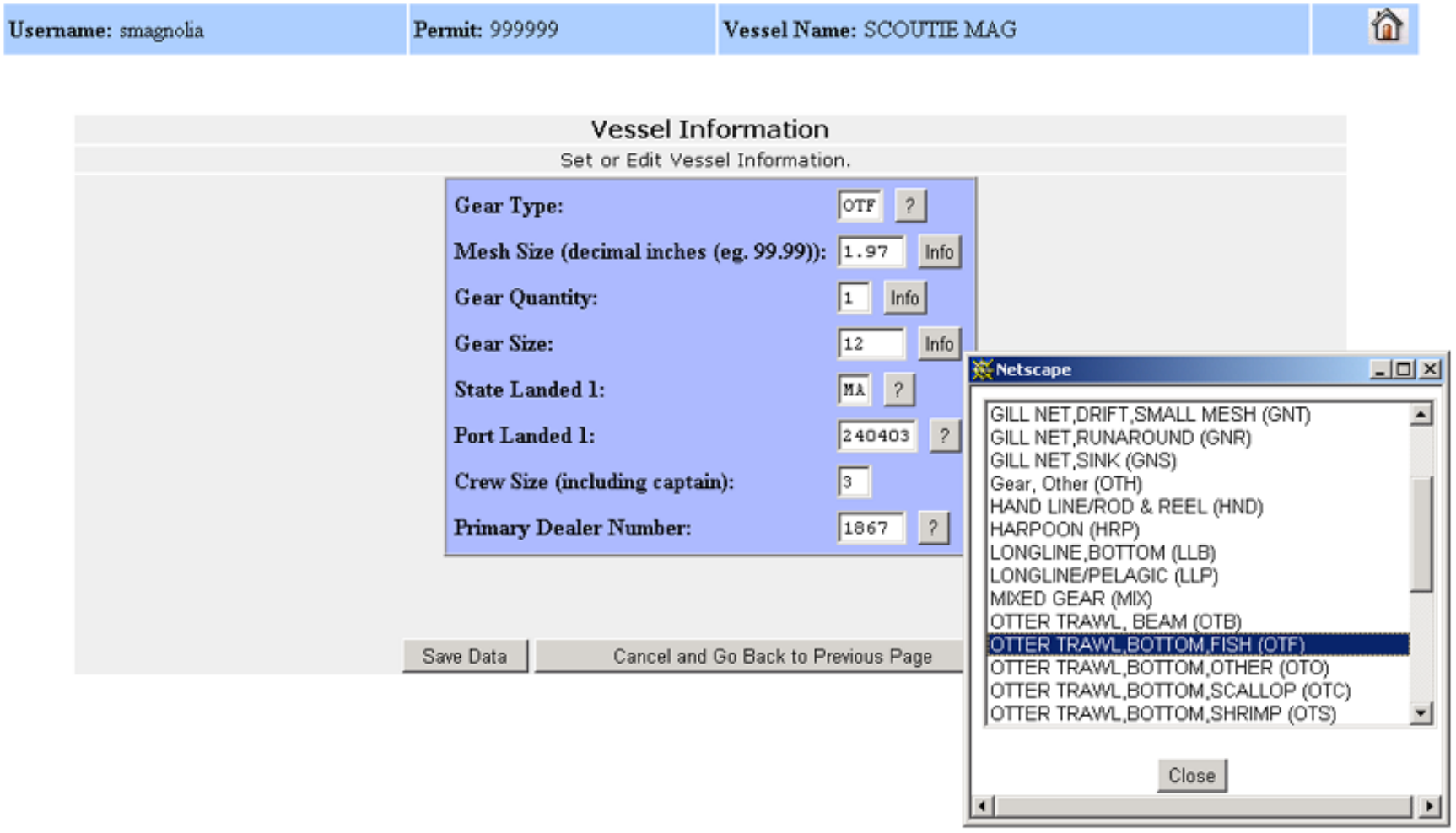


Figure 6. Web page used to define a trip.

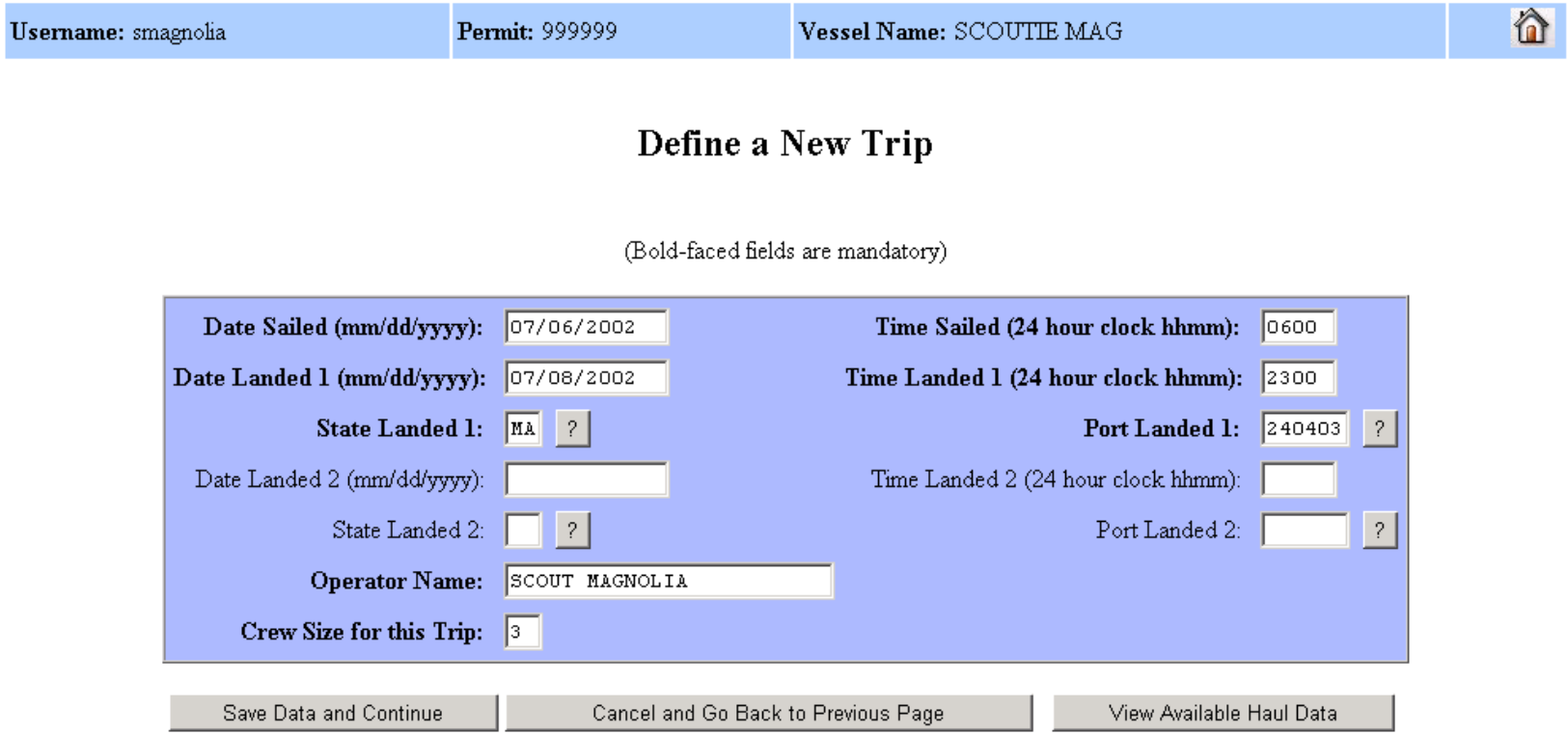


Figure 7. Web page that lists hauls with matching begin and end of tow dates (top box) and hauls with errors (shaded bottom box) such as Haul 2, for which there is no end of tow record.

Username: smagnolia	**Permit:** 999999	**Vessel Name:** SCOUTIE MAG	**DateSail:** 07/06/2002	**DateLandl:** 07/08/2002	

Haul Data

Review and edit dates and times for each haul record below.

Haul #	Haul Begin Date	Haul Begin Time	Haul End Date	Haul End Time	Hours Fished		
1	07/06/2002	1526	07/06/2002	1753	2.45	Edit	Delete

HAULS WITH ERRORS

Haul #	Haul Begin Date	Haul Begin Time	Haul End Date	Haul End Time	Error		
2	07/06/2002	1823			BEGIN ONLY	Edit	Delete

Add a New Haul Record

Figure 8. Web page used to enter data to create the missing end of tow record for Haul 2.

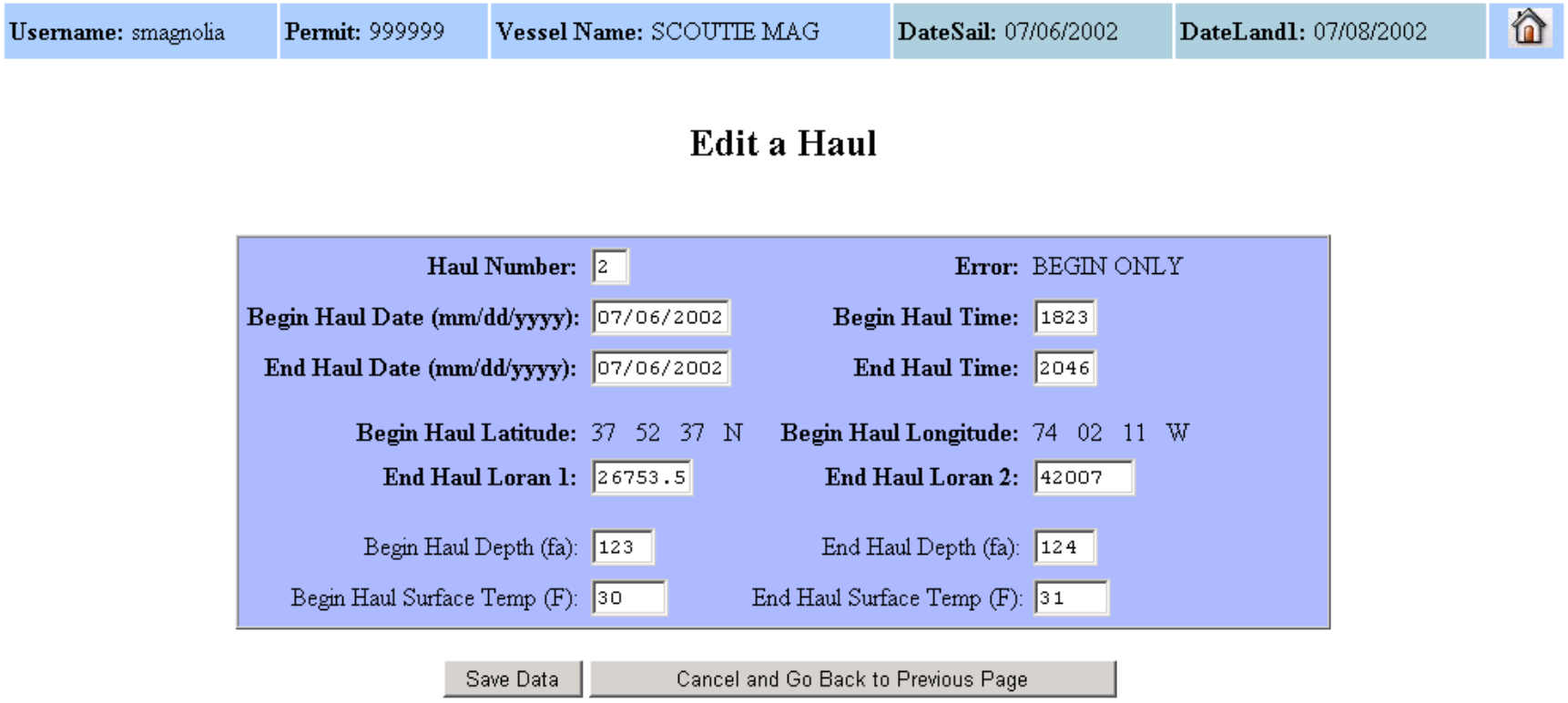


Figure 9. Web page used to enter or edit data pertaining to a catch record.

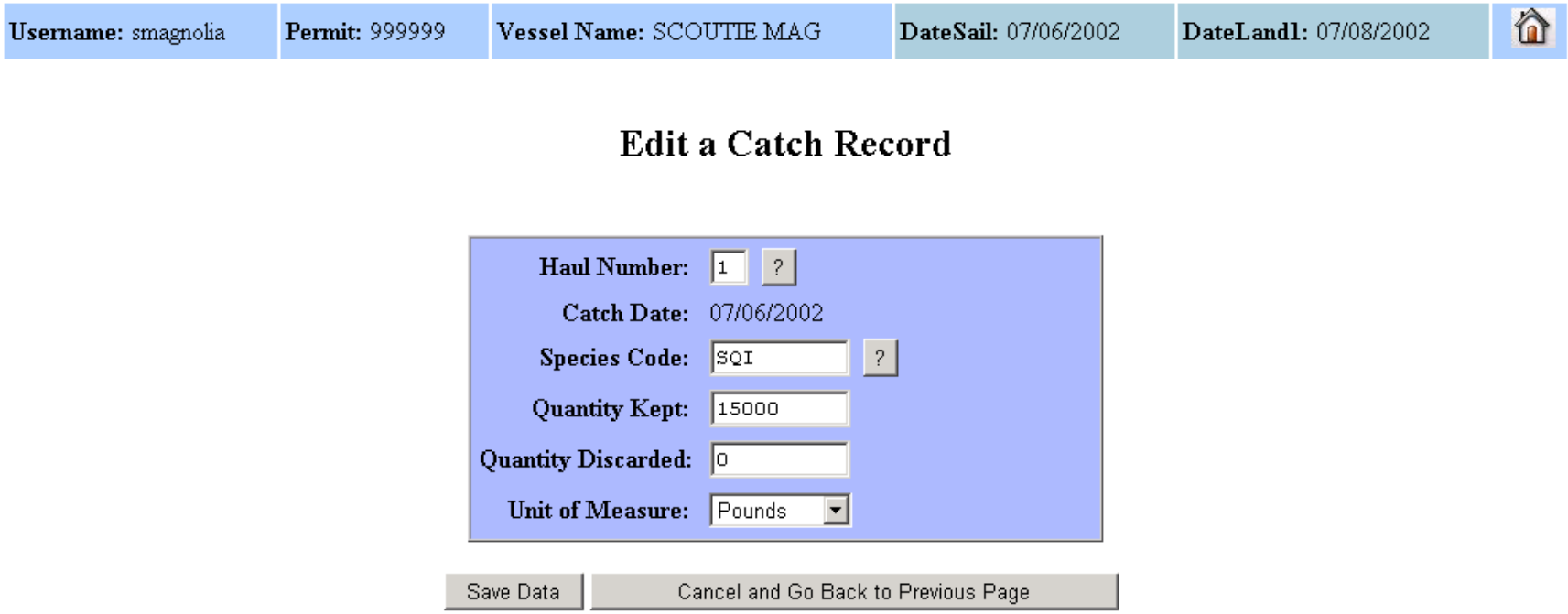


Figure 10. Web page used to edit enter or edit data pertaining to a gear record and to designate the hauls to which the gear data apply (checked boxes). Data may be automatically entered into the four gear fields shown via the vessel defaults page.

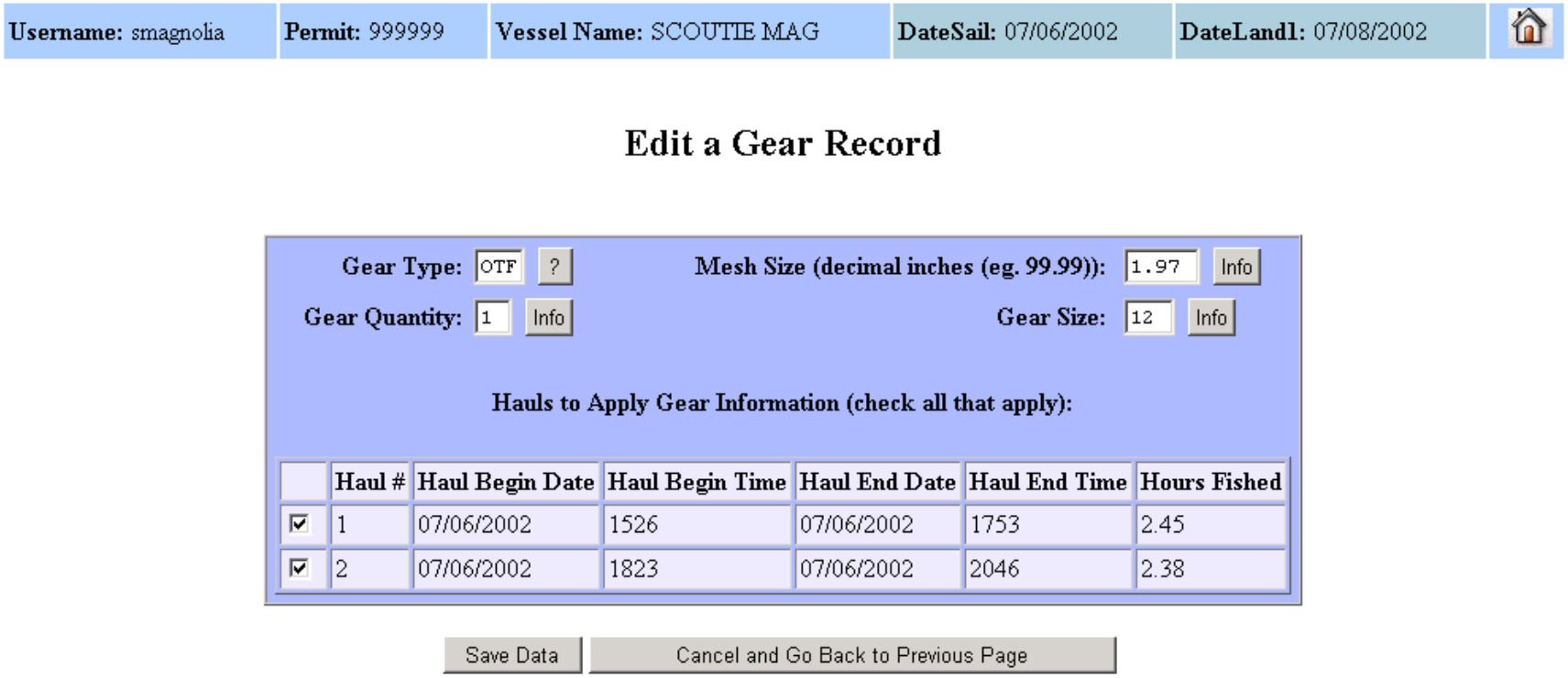


Figure 11. Web page used to partition the amount, by species, of the total trip landings sold each dealer.

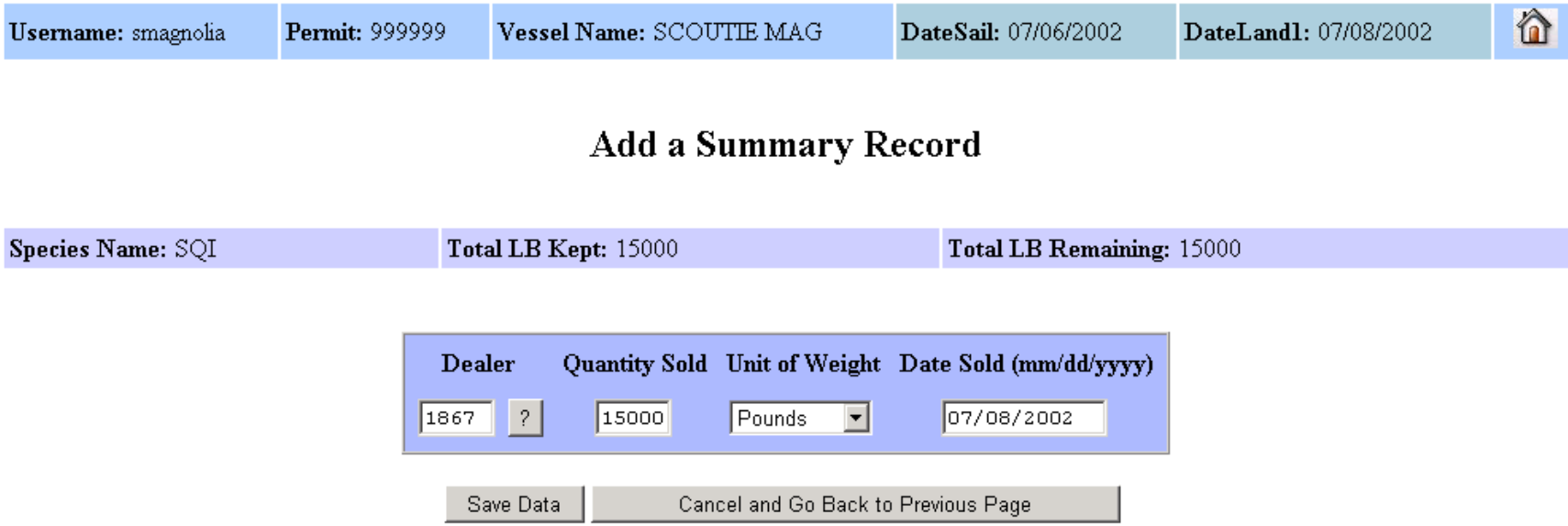


Figure 12. Summary of total trip landings, by species, sold to each dealer.

Username: smagnolia	**Permit:** 999999	**Vessel Name:** SCOUTIE MAG	**DateSail:** 07/06/2002	**DateLandl:** 07/08/2002	

Landings Summary and Dealer Data

Species	Total Landed	Unit of Measure
SQI	15000	LB

Dealer	Quantity Sold	Unit of Measure	Date Sold (mm/dd/yyyy)
1867	15000	LB	07/08/2002

Add Dealer | Edit

Continue to VTR Summary Page | Go Back to Previous Page

Figure 13. Web page representing the final product, reorganization of the summarized trip data into a format similar to a VTR logbook form, and choosing the 'Confirm' button certifies that data submitted by the vessel operator is complete and correct.

Username: smagnolia	**Permit:** 999999	**Vessel Name:** SCOUTIE MAG	**DateSail:** 07/06/2002	**DateLandl:** 07/08/2002	

VTR Summary Page

This screen reorganizes the trip data into a format similar to a VTR logbook form. Please review and verify that the data on this page is correct. By choosing the "Confirm that all Trip Related Data is Correct", you are accepting that all data is correct and will be reported as a Vessel Trip Report (in lieu of submitting a logbook entry) and will not be allowed to make any further edits. If you find any data in error, choose the "Go Back to Main Page" button and make corrections before confirming the data. If you choose "Go Back to the Main Page", all of the changes you have made to this trip have been saved to this point.

Vessel Trip Information

Vessel Name	Hull Number	Permit Number	Date Sailed	Time Sailed	No. of Crew
SCOUTIE MAG	999999	999999	06-JUL-02	0600	3

Port Landed	State Landed	Date Landed	Time Landed
NEW BEDFORD	MA	08-JUL-02	2300

Figure 14. Gear, area and catch section of the "VTR Summary Page".

Gear, Area and Catch Information

Each of the following blocks represent one page of VTR logbook

Gear Fished	Mesh/Ring Size (inches)	Quantity of Gear	Size of Gear	Chart Area	Avg Depth	No. of Hauls	Avg Tow/Soak Time (hrs)
OTF	1.97	1	12	626	118.50 fa	2	2.42

Species Name	Code	Quantity Kept	Unit of Measure	Quantity Discarded
JOHN DORY	JDO	0	LB	500
SQUID / ILLEX	SQI	15000	LB	0

Figure 15. Dealer section of the "VTR Summary Page".

Dealer Information

Dealer Name	Dealer Number	Species	Amount Sold	Date Sold
A M LOOK CANNING CO	1867	SQI	15000	08-JUL-02

By choosing the Confirm button you are certifying that all information provided through this website is true, complete and correct to the best of your knowledge, and made in good faith. Making a false statement through this website is punishable by law (18 U.S.C. 1001).

Confirm that all Trip Related Data is Correct | Go Back to Main Page

Figure 16. Interactive mapping and querying of tow-based catch per unit of effort (CPUE) data allows vessel operators to visualize their logbook data via secure web sites.

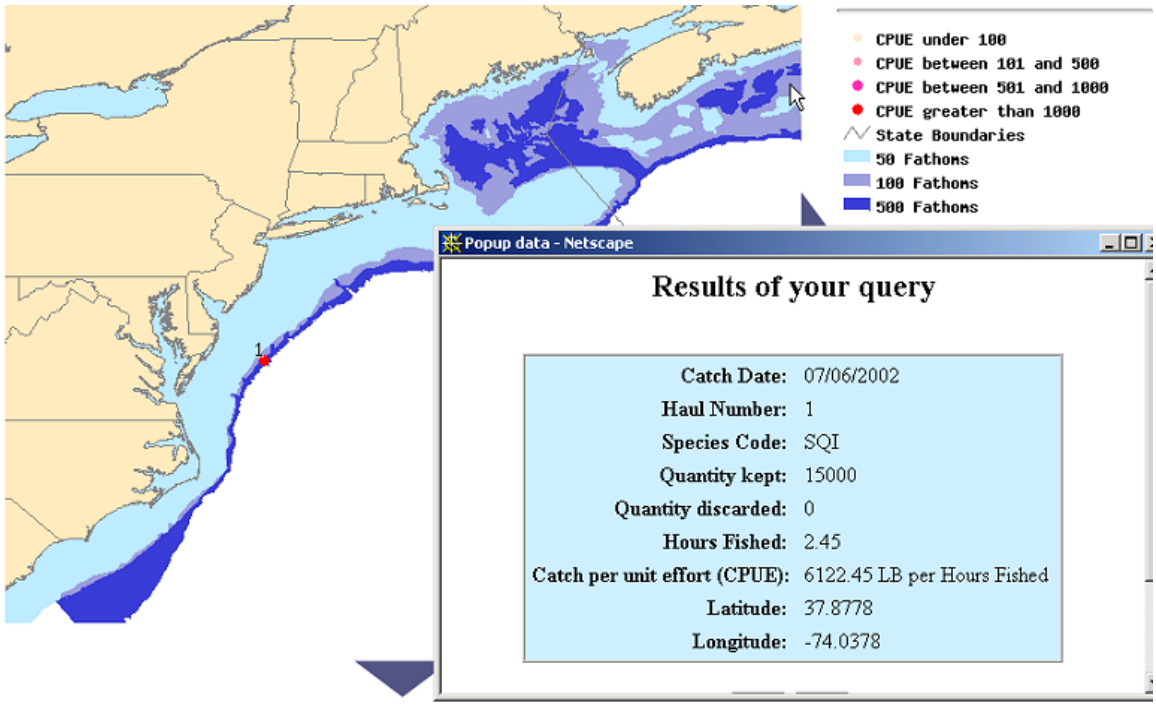


Figure 17. Website options available to vessel operators to produce summary reports of personal electronic logbook data.

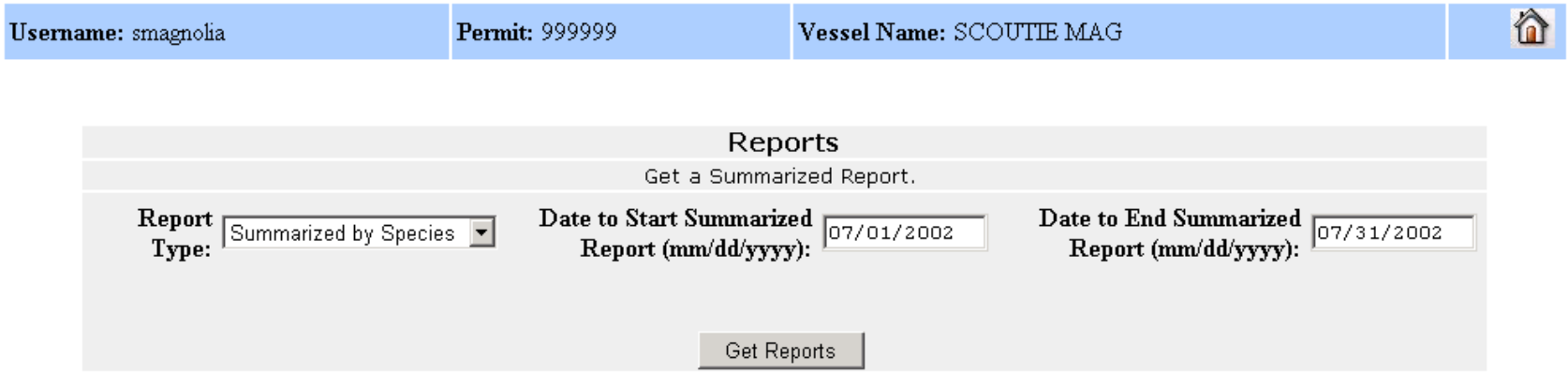


Figure 18. Example of an electronic logbook report summarized by species.

Username: smagnolia	**Permit:** 999999	**Vessel Name:** SCOUTIE MAG	

Reports

Summarized Report from 07/01/2002 to 07/31/2002.

Report Summarized by Species

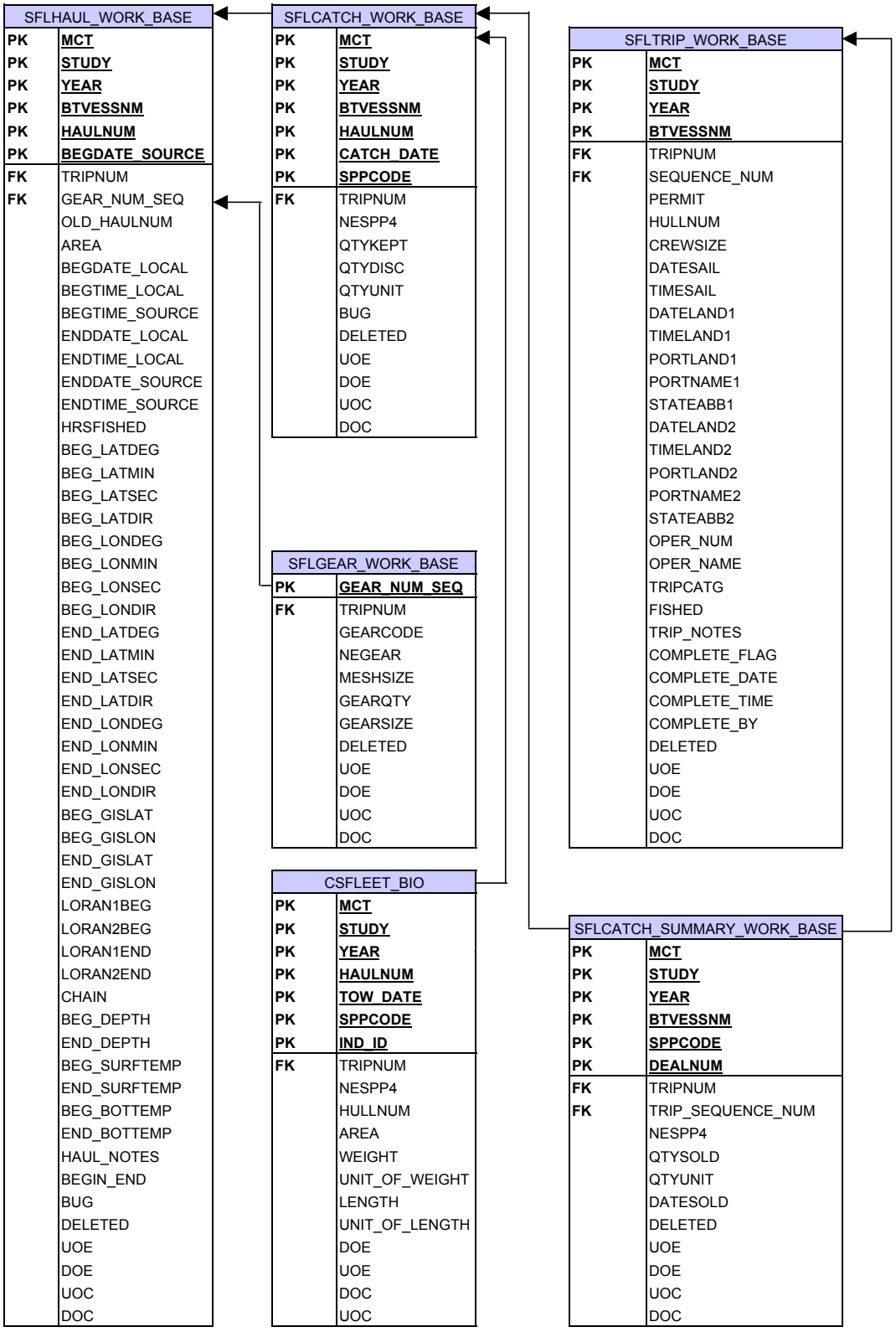
Species Name	Amount Kept	Amount Discarded	Unit of Measure
CLAM, ARCTIC SURF	100	0	LB
JOHN DORY	0	500	LB
SQUID / ILLEX	42345	0	LB

Appendix 1. Oracle database model for raw data e-mailed from study fleet vessels participating in the 2002 electronic logbook reporting project. Link fields are bold-faced and underlined. 'PK" represents primary key.

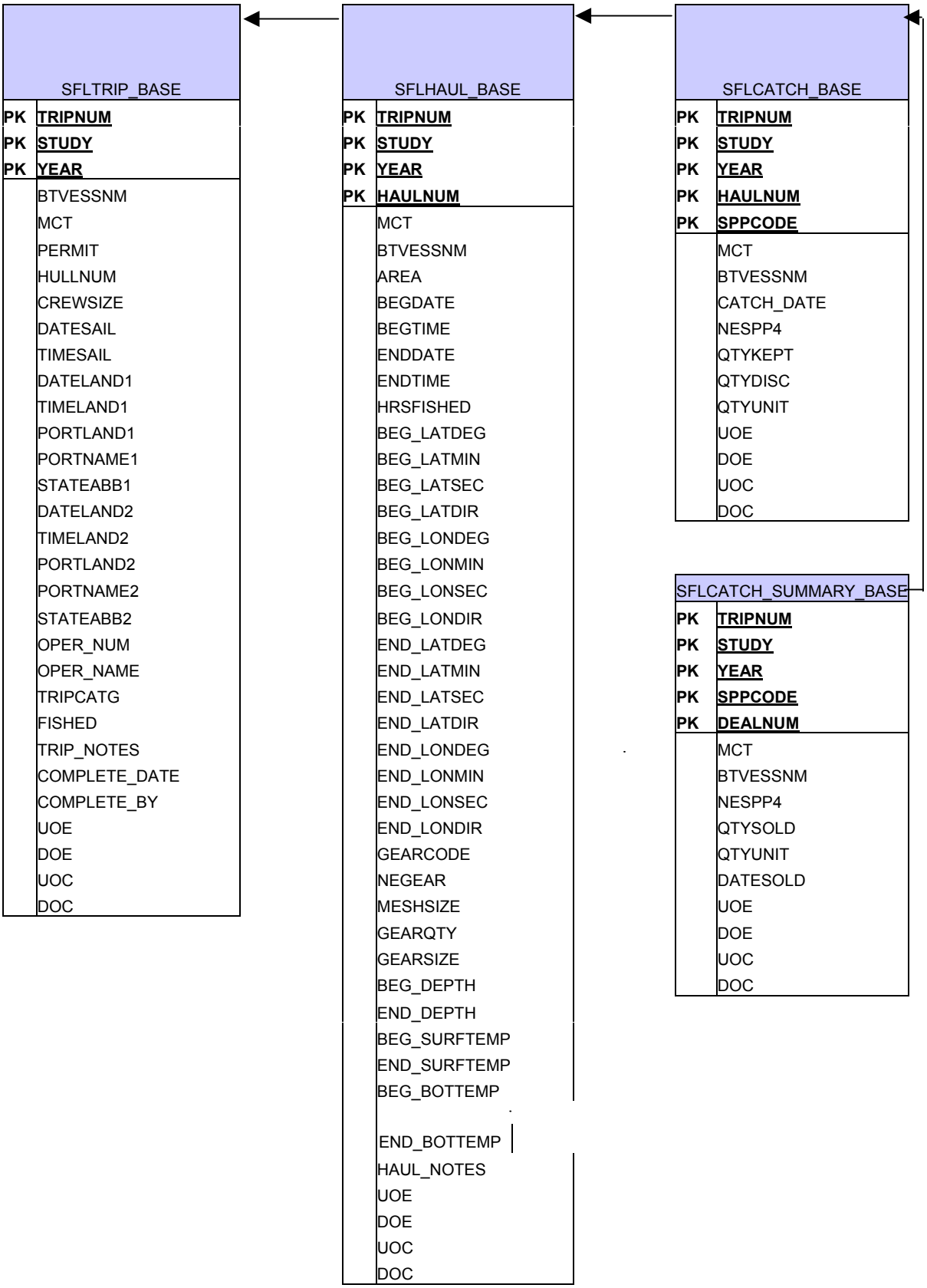
ILLEXTOW_RAW	
PK	**MCT**
PK	**BTVESSNM**
PK	**TOWNUM**
PK	**SENTDATE**
	SENTTIME
	LATDEG
	LATMIN
	LATSEC
	LATDIR
	LONDEG
	LONMIN
	LONSEC
	LONDIR
	MACRONUM
	BEGIN_END
	DEPTH
	SURFTEMP
	BOTTEMP
	TOWBEGDATE
	TOWBEGTIME
	TOWENDDATE
	TOWENDTIME
	LORAN1BEG
	LORAN2BEG
	LORAN1END
	LORAN2END
	TOWCOMMENT
	DOE
	EMAIL_DATE
	MESSAGE_ID
	PROCESSED

ILLEXCAT_RAW	
PK	**MCT**
PK	**BTVESSNM**
PK	**TOWNUM**
PK	**SENTDATE**
PK	**SPPCODE**
	SENTTIME
	LATDEG
	LATMIN
	LATSEC
	LATDIR
	LONDEG
	LONMIN
	LONSEC
	LONDIR
	MACRONUM
	LBS_KEPT
	LBS_DISC
	CATCH_DATE
	DOE
	EMAIL_DATE
	MESSAGE_ID
	PROCESSED

Appendix 2. Oracle database model for tables containing logbook data that are updated based on data submitted by vessel operators through secure, password-protected web sites.



Appendix 3. Oracle database model for electronic logbook data summarized similar to the Vessel Trip Report (VTR) database. "PK" represents primary key and "FK" represents foreign key.



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