Habitat Ecosystem Assessment Tool (HEAT) Survey Results

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ABSTRACT

The Habitat Alteration Assessment Tool (HAAT) is an application of a quantitative fish habitat assessment tool for use in evaluating proposals affecting lacustrine fish habitats in the Great Lakes area. The Habitat Ecosystem Assessment Tool (HEAT) is a development that stems from expanding HAAT to include new functionality and new variables such as water levels and temperature. With further development the updated tool will also expand Lake HEAT beyond the Great Lakes. Lake HAAT/HEAT incorporates fish distribution information, fish guild information, life stage-specific habitat associations, and suitability and weighted suitable area calculations. A new prototype version of the tool will also be developed for rivers building on the earlier River HAAT model developed by Minns (2010). The tool is flexible to user choices of fish lists, guild assignment, guild weighting to allow for inclusion of habitat and fisheries goals. The software package allows pre- and post-project assessment of limnological and physical habitat changes and their impact on fishes, through scenario-testing. The goal of this phase of study is to continue the development of the tool through input from current and potential users as to their requirements and expectations from the software. Thus, 106 past, current and future/potential users of HAAT/HEAT were asked to participate in a workshop and complete a survey regarding various topics including: knowledge of the tool modules, ideas on additional variables and standards as well as issues with the existing tool. Results from the survey and workshop supplied important input into how the software should be migrated to a new platform, and that additional benefits should be realized, including better user support, a better user interface, more frequent updates, and most importantly improved standardization of scenarios input and output. As tool enhancement continues further liaison with users will be pursued to continue to refine the tool.

RÉSUMÉ

L'outil d'évaluation de l'altération de l'habitat (HAAT) est un outil d'évaluation quantitative de l'habitat du poisson utilisé pour évaluer les propositions touchant les habitats lacustres du poisson dans le secteur des Grands Lacs. L'outil d'évaluation de l'habitat et de l'écosystème (HEAT) est une application développée à partir de HAAT, qui possède de nouvelles fonctionnalités et de nouvelles variables telles que le niveau d'eau et la température. Éventuellement, l'outil Lake HEAT pourra s'appliquer à des secteurs au-delà des Grands Lacs. Lake HAAT/HEAT intègre des renseignements sur la répartition des poissons, la guilde de poissons, les habitats fréquentés aux différentes étapes du cycle de vie, ainsi que les calculs de qualité de l'habitat et de la superficie propice pondérée. Une nouvelle version prototype de l'outil sera également développée pour les rivières. Elle s'inspirera du modèle River HAAT précédent, développé par Minns (2010). L'outil permet aux utilisateurs de choisir la liste de poissons, l'affectation et la pondération de la guilde, pour inclure les objectifs relatifs à l'habitat et à la pêche. Le progiciel permet d'évaluer les changements limnologiques et physiques de l'habitat, ainsi que leur impact sur les poissons, avant et après le projet, en mettant des scénarios à l'essai. L'objectif de cette phase d'étude est de poursuivre le développement de l'outil grâce aux contributions des utilisateurs actuels et potentiels, quant à leurs besoins et à leurs attentes face au logiciel. Ainsi, 106 utilisateurs passés, actuels et futurs ou potentiels de HAAT/HEAT ont été invités à participer à un atelier et à répondre à un sondage sur divers sujets, tels que : la connaissance des modules de l'outil, des suggestions d'autres variables et normes et les problèmes rencontrés avec l'outil existant. Les résultats du sondage et de l'atelier ont fourni des commentaires importants sur la façon dont la migration du logiciel vers une nouvelle plate-forme devrait se faire, et indiqué qu'elle devrait procurer des avantages supplémentaires, tels qu'un meilleur

soutien aux utilisateurs, une meilleure interface utilisateur, des mises à jour plus fréquentes et surtout, une meilleure normalisation des intrants et extrants des scénarios. L'amélioration de l'outil se poursuit, et nous continuerons à communiquer avec les utilisateurs pour rendre l'outil plus précis.

1.0 INTRODUCTION

Within the fisheries science, advocacy and protection community including internal and external clients, there has been a need for methods, models and tools for assessing project impacts on fish ecosystems and for evaluating the potential for offsetting these impacts. The Habitat Alteration Assessment Tool (HAAT) has managed to fill this void and is frequently employed by the Department of Fisheries and Oceans (DFO) within the Fisheries Protection Program (FPP) for project impact assessments. HAAT is the application of a quantitative fish habitat assessment tool for use in evaluating proposals affecting lacustrine fish habitats in the Great Lakes area. HEAT is a web-based software tool that quantifies the suitability of an aquatic site or subarea to fishes and calculates a weighted habitat supply for one or more scenarios in order to estimate the net change in productive capacity of fish habitats. A habitat suitability matrix (HSM) is used to estimate the habitat suitability indices along with the rules and criteria that must be applied to allow evaluation of fish habitats (Minns et al., 2001).The HSM model uses pooled matrices representing the aggregate habitat preferences of species by life stage to ensure that all needs during that critical stage are met for survival for each species. Databases on fish species in different regions, and their habitat needs or associations at different life stages are used to determine relative suitability and supply based on user-specified or default fish lists. The software package allows pre- and post-project assessment of limnological and physical habitat changes and their impact on fishes, through scenario-testing. HAAT was updated and expanded, and has been rebranded as the Habitat Ecosystem Assessment Tool (HEAT). All the modules that were found in HAAT are present in HEAT but modifications have allowed for better user interface and accessibility. Thus, HEAT, as mentioned in this paper, will include its predecessor HAAT when mentioned. Water levels and temperature will be added to the existing assessment variables and guidance on incorporating water-level data into scenarios to address changing depths that occur with some development projects such as infills.

There are currently two versions of HEAT available, a lake version and a river version. The river version is located offline and not commonly applied and is less advanced and simpler than Lake HEAT. Lake HEAT incorporates fish distribution information, fish guild information, life stage-specific habitat associations, suitability, and weighted suitable area calculations. It incorporates water depth, substrate type, and vegetative cover as variables to assess changes in pre- and post-scenarios. Throughout this paper, the general term “HEAT” will be applied to indicate Lake HEAT unless otherwise specified. To date, mainly water development projects, including compensation (now offsetting), or restoration projects have been assessed using HEAT for regulator evaluations (Minns et al., 1999a and Minns et al., 1999b, Minns et al., 2006, Gertzen et al., 2012). HEAT is most commonly used to compare pre-construction fish habitat suitability to post-construction conditions to estimate net change of productive capacity of fish habitats.

This software tool has a much wider applicability than its current use because of the underpinning ecological theory and the transferability of the methods employed. The tool is flexible to user choices of fish lists, guild assignment, guild weighting to allow for inclusion of habitat and fisheries goals. Future development will also expand HEAT beyond the Great Lakes. A new prototype version of the tool will also be developed for rivers building on the earlier River HAAT model developed by Minns (2010).

The goal of this phase of study is to continue development of the tool through input from current and potential users as to their requirements and expectations from the software. Thus regulatory, policy, industry, and science users were engaged in prioritizing module development of HEAT. In order to do this we held a workshop and surveyed current users and potential users to address primary objectives:

- the expanded scope and desired functionality of HEAT;
- upgrades to the functionality historically available in its predecessor HAAT;
- discuss methods for interfacing with the model;
- user documentation needs; and
- assess needs for user training.

These workshops and surveys were held between December 2012 and January 2013. In total, 106 past, current and future/potential users of HAAT/HEAT were contacted for participation. During the workshop, an open dialogue helped inform efforts. The survey was held online and users were asked questions regarding various topics including knowledge of the tool modules, ideas on additional variables and standards and issues with the existing tool. These surveys focused on the continued improvement of the lake version of HEAT only. Subsequent development for the river version will follow.

As the software is migrated to a new platform additional benefits should be realized, which includes better user support, a better user interface, more frequent updates, and most importantly improved standardization of scenarios input and output that may be used in DFO management and regulatory decisions. The tool could be applicable to many sectors beyond FPP by using a broader suite of variables for before- and after-scenario testing, including climate change impacts with the inclusion of temperature as an assessment variable in fish habitat calculations.

Three particular areas that have been highlighted as priority requiring future development identified by cross-sectoral users of the tool: 1) develop regional modifications for national application of Lake HEAT; 2) to scope a prototype River version of the HEAT model, and 3) to scope and implement methods of converting habitat supply into measures of fisheries productivity.

As tool enhancement continues, further liaison with users will be pursued to continue to refine the tool to meet user's needs.

2.0 METHODS

2.1 IDENTIFICATION OF PARTICIPANTS

Past users were identified as those who had contacted us to obtain a log-in to the software. This list of users had been maintained since the initiation of the program. In some cases, users had passed on their log-in to colleagues, thus we contacted all documented users and asked them to advise if there were multiple users using a single log-in identity. We also asked those users to send names of colleagues that would be potential future users. A list was compiled of all past, present and potential future users and these users were invited to attend the workshops. Once information was gathered

from the survey, One Hundred and six past, current and future potential users of the HAAT/Habitat Ecosystem Assessment Tool were asked to participate in the survey.

2.2 WORKSHOP

An initial meeting was held with participants to gain information on the beta version of HEAT, assess how stakeholders would like to be involved and discuss future directions of the application. Twenty-five individuals attended those meetings.

A workshop was than planned for 2 months after the preliminary meeting to give a detailed course on how to use and run the current application. To provide a common understanding of the purpose, scope and approach to the workshop, discussions began with an overview of the workshop objectives and two presentations were given at which 1) reviewed the historical development and application of HAAT/HEAT, and 2) provided an overview of anticipated plans for its redevelopment and expansion into the HEAT implementation.

During the workshop, participant experience with the Tool was discussed in order to assess the background of participants. Following this, a list of desired functions to be implemented in HEAT was developed. This list formed the basis for a pair-wise value ranking to establish relative priorities for function inclusion within HEAT. Once the priority ranking was complete workshop discussions focused on themes:

- Issues / base information review;
- Implementation timing;
- Output documentation / standards;
- Defaults and flexibility;
- Software (web vs. download, command window vs. user interface);
- Data storage / security / sharing;
- Training / Support;
- National application;
- River systems; and
- Governance

Following this, a survey was given to participants as described in the next section.

2.3 SURVEY

In order to assess the demands of HEAT users for improvements and upgrades to HEAT, a survey was designed and distributed to current and potential users. Between December 2012 and January 2013, 106 participants were asked to complete a survey. The survey covered various topics including knowledge of the existing tool modules, possible improvements needed with the existing tool, and suggestions for additional variables and standards development, including new features and potential applications as well as and standards and issues with the existing tool.

During the workshop, participants were given an introduction to the software use and details of the technical science of how the program works. A demonstration of the application of the existing tool was also supplied live. Users were asked to provide information about their needs for added functionality and improvements in the software

and its delivery through an online survey. Potential end-users of HEAT included those who were (i) developing, changing or restoring aquatic environments, (ii) assessing the impacts of different stressors more broadly (e.g. climate change, dams/dyking, invasives, development), or (iii) examining the role of habitat/ecosystem features in fisheries productivity or for fish species-at-risk. A broad spectrum of past and potential users was engaged for these purposes to help inform and guide the decision-support tool changes. All questions posed in the survey are listed in Appendix A.

3.0 SURVEY RESULTS

Fifty-one users started the survey, however only 37 surveys were completed. All responses received were used in the tabulation of results. Users worked in a variety of organizations as shown in Figure 1.

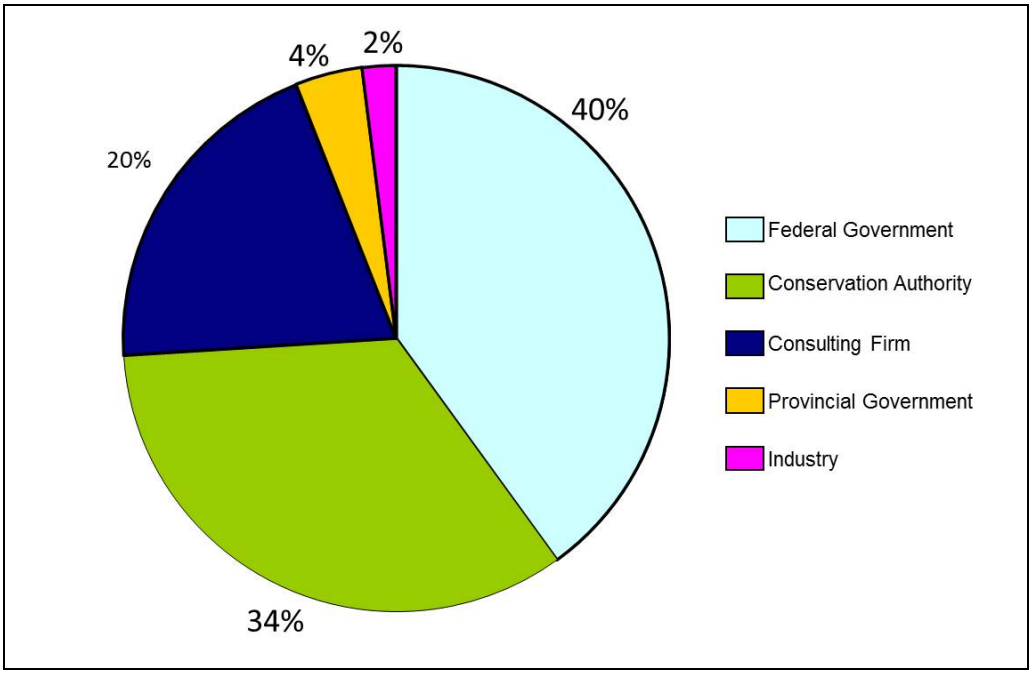

Figure 1. User work organization (50 respondents)

The majority of users indicated that they are future or potential users of HEAT (Figure 2). Of 49 respondents, 13 (26.5%) indicated they were past users, nine (18.4%) indicated they were current users, and 36 (73.9%) indicated they were future or potential users of HEAT. Respondents could choose more than one category, for example if they are current and future users of HEAT they could select both options. Most past users, who no longer use the Tool, provided the reason for this as being a new job role. Several past users did indicate that they found the tool difficult to use. Issues with the tool that were raised include:

- The tool required labour intensive work collecting data (suggested that classes of substrates could be created that would reduce the work load).
- The value of sand habitat was such that it is challenging to compensate for its loss.

- Difficulty getting assistance from qualified and experienced users.

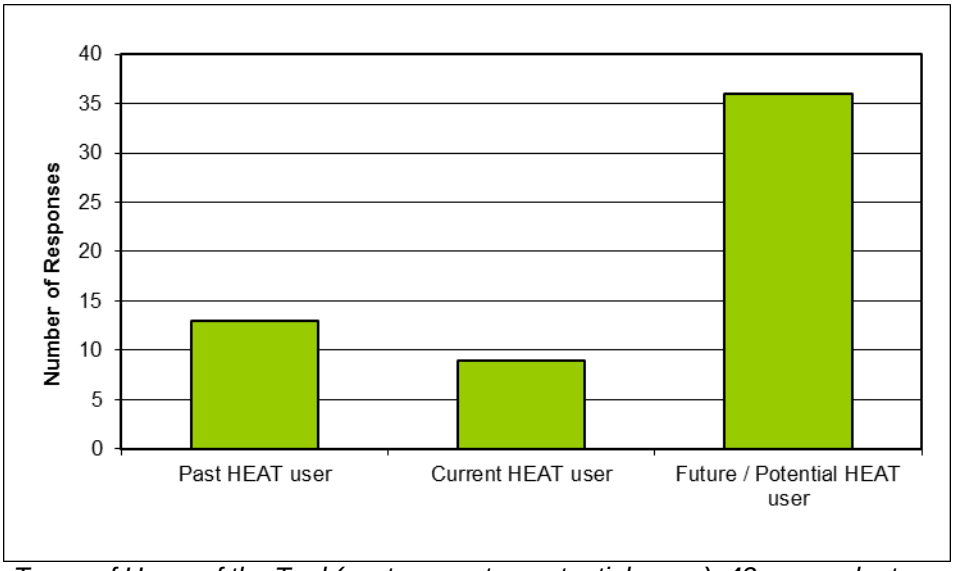

Figure 2. Types of Users of the Tool (past, current or potential users), 43 respondents

3.1 TOOL POSITIVE ATTRIBUTES

Many users provided comments on positive aspects of using HEAT and these include:

- Quantitative tool to ensure that adequate compensation is provided for referrals.
- Standardized and accepted by regulators.
- Helps with discussions of compensation option with proponents.
- Performs suitability calculations.
- Built-in organization of fish lists and guilds.

Some specific comments from the respondents to this question include:

- Being able to see the effects of development and determine compensation is enough
- Eliminates the “black box” when discussion compensation with clients.
- Ability to tackle targeted restoration for desired thermal guilds
- The ability to assess habitat changes in a consistent, transparent manner
- Excellent tool for balancing fish habitat compensation on the Great Lakes
- Performs suitability calculations and has a built in organized list of fish guilds
- The ability to customize fish community

There were many comments from users outlining issues that they have with the current tool, including:

- The tool is not that user friendly and training is necessary to be able to use it properly.
- The software can be cumbersome to use and glitches are often noted.
- The use of sand in the model as the preferred substrate for fish habitat is a concern when results suggest that restoration efforts have a negative impact on

the habitat. (note that this was an assumption of the respondent and not true of the actual model)

- Specific issues such as differential accessibility and absolute productivity among patches.
- Some elements convert qualitative to quantitative data poorly.
- Not useful for riverine settings.
- Limited file size allowed (~1200 habitat patches (rows) is the maximum limit within the upload file).
- Fish lists not up to date.

3.2 FUNCTIONALITY OF HEAT

Just over half of respondents (56%) indicated that they would prefer HEAT to be a web-based tool as compared with a downloadable tool. Slightly more respondents from the federal departments and conservation authorities preferred a web-based tool but the majority of consultants preferred to use HEAT in a downloadable format (Figure 3).

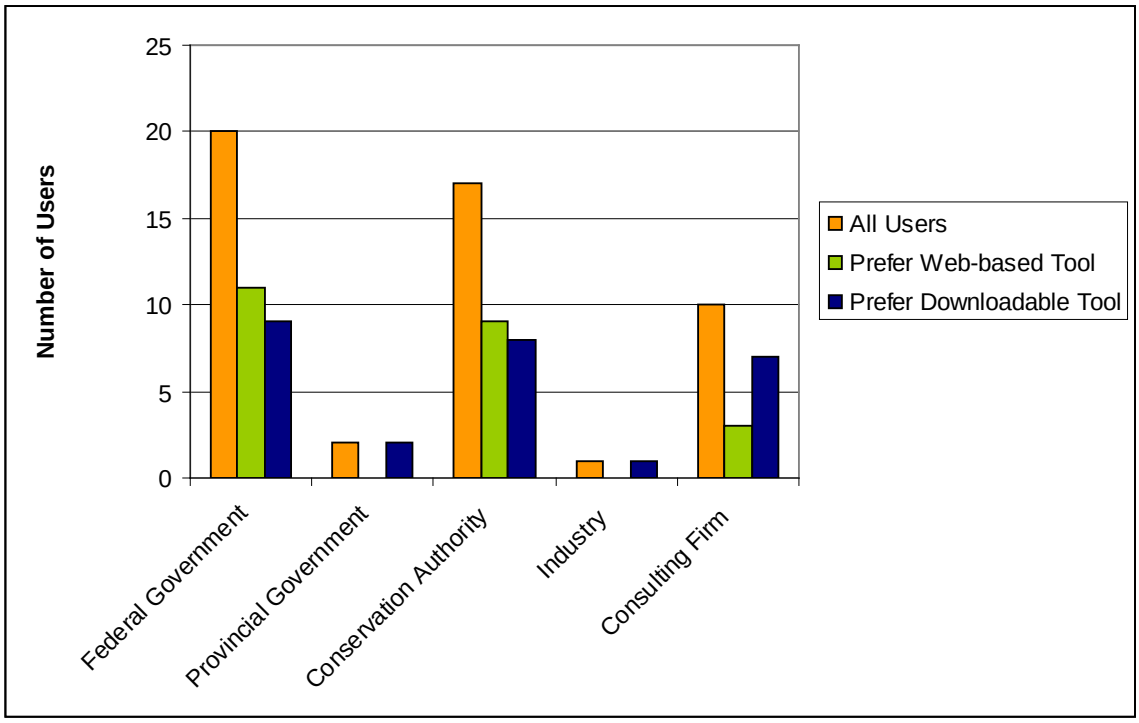

Figure 3. Preferences for HEAT format by organization

Mapping and GIS inputs were the overwhelming preference for features to be incorporated into the new Tool. Over 90% of respondents indicated that they would like to have access to a manual, training and support, and example scenarios. A smaller number (75%) indicated that they would find a Frequently Asked Questions section useful. A basis user manual is in preparation and will provide the steps to run a scenario using a simple infill project as an example.

Eighty-one percent of users responded that they would like to be able to share data files through mechanisms such as a remote server or the “cloud” but there were

several concerns regarding ensuring privacy and security. Several suggestions were put forth including password protection or relying on FTP sites instead.

3.3 EXISTING FEATURES AND MODULES IN HEAT

As seen in Figure 4, there is interest in using HEAT for a variety of assessments, with the majority of users using it for assessing lake development projects. Restoration activities have also been identified as projects that a number of users would like to assess using HEAT.

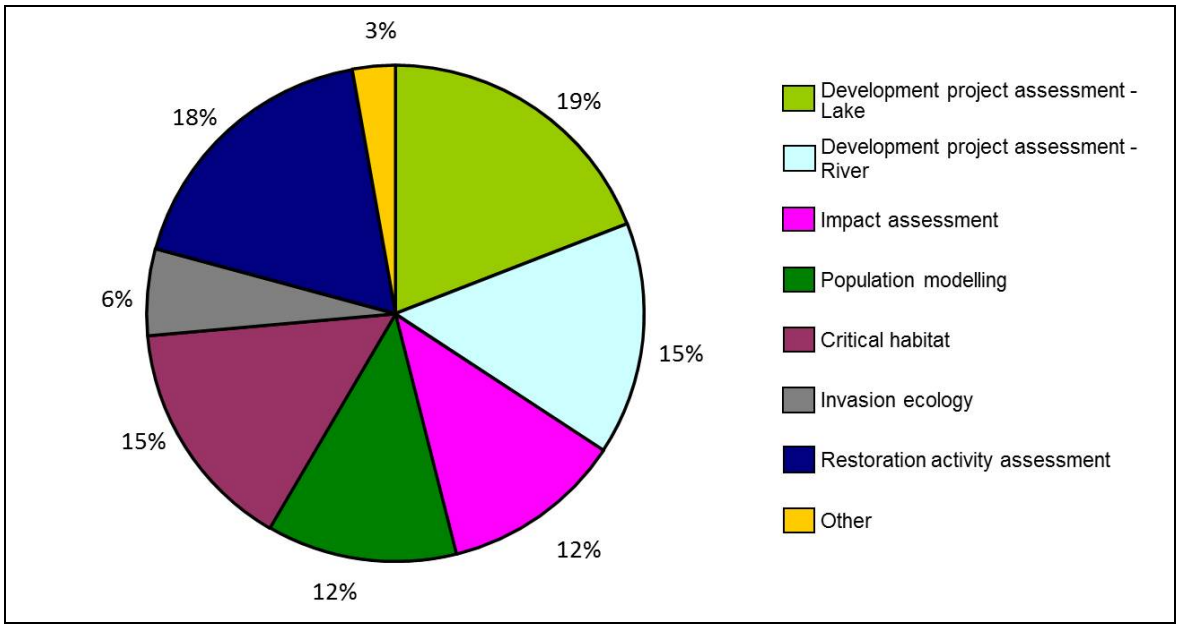

Figure 4. Preferred uses for HEAT

When this data was broken down by organization (Figure 5), the interest in using the Tool for the top five activities is fairly even across the board with consultants less likely to use the tool for population modeling than for project assessment. Federal government staff indicated that they would use the tool more often for assessment of lake projects and restoration activities than other activities.

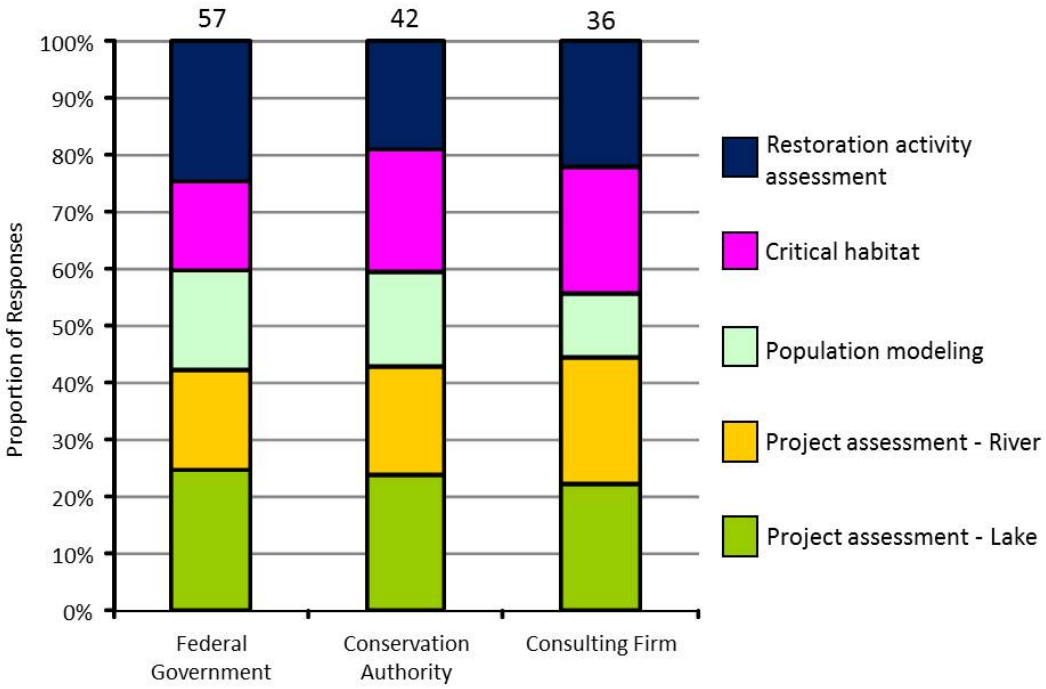

Figure 5. Top five uses of HEAT by organization

Within the Definition Modules, of current users, 23 responded as to whether they had made changes to features within the module to customize their assessment (Figure 6). The results indicate most users are aware of the features and about one-third of users have made changes.

Within the Location Module, 22 users indicated whether they have made changes to the lake species lists or the tertiary watershed species lists (Figure 7). More users have made changes to the lake species lists than tertiary watershed lists.

The vast majority of users are not aware that there is an Uncertainty Analysis Module or a Temporal Analysis Module in the Tool. A small number of users are aware of the modules but haven't used them. Similarly, most users have not used the various reports that are available in the Report Module. Two reports (Weighted Suitable Areas report and Areas and WSA by Area Type report) were identified as being used more often than others as these are the two reports that provide the most useful information when assessing a development project. Seventy-eight percent of users indicated that they have not used the Print Module in the Tool. Most users copy the reports into their excel spreadsheets directly.

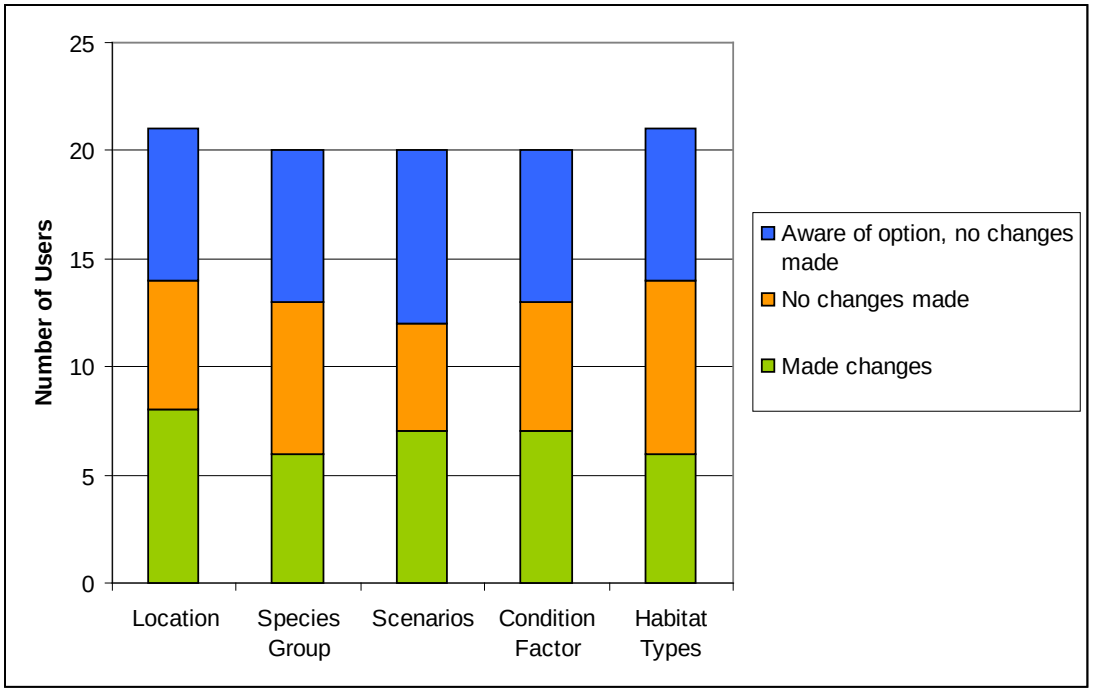

Figure 6. Features of the Definition Module that have been changed, 21 respondents

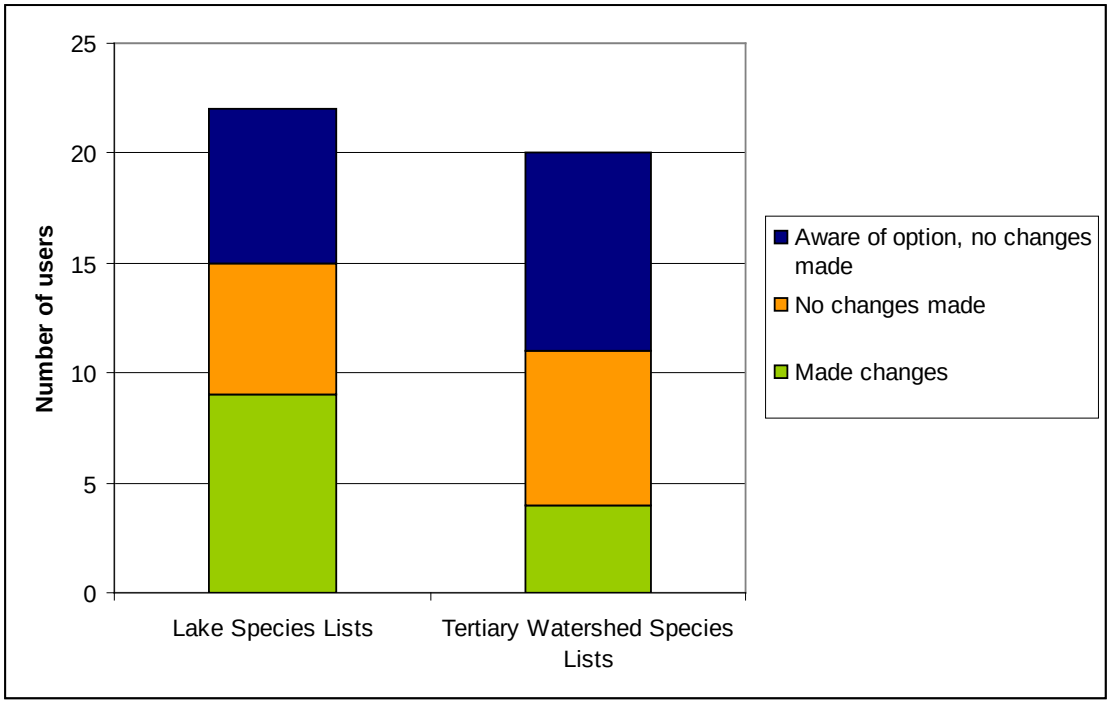

Figure 7. Features within the Location Module that have been changed, 21 respondents

3.4 FUTURE MODULES IN HEAT

Ninety-one percent of users indicated that they thought temperature would be an important addition to the assessments, with the highest number of responses from

Conservation Authorities. Most users (87%) also indicated that they would like to have the flexibility in specifying new variables and their associated suitabilities. In addition to variables that have already been identified (habitat connectivity / accessibility and adjacent habitat), several other variables were suggested:

- For lakes, temperature variable should include vertical structure, light and oxygen profiles
- Water quality
- Groundwater discharge
- Sub-watershed conditions including % forest cover, % wetland cover, % impervious cover and water balance
- Identifying Critical Habitat for Species At Risk (SAR) and giving the associated patch(es) a higher rank
- Incorporating other databases
- Habitat quality
- Flow regimes
- Differential patch accessibility by fish species or group and scenario.
- Absolute productivity scalars by ecotype
- Productivity reduction for contaminated sediments or water (other than Condition Factor or Quality Adjustment Factor)

With respect to suitability models in HEAT, 78% of users indicated that they would like to be able to change or replace the models. Several comments were made regarding this topic, including:

- Consider the possibility of combining with other models such as River2D, CHAP
- Need to ensure that structure and consistency is maintained in suitability models across projects and users
- Will be able to incorporate site specific components
- Tool needs to be standardized for consistency
- This option would not be helpful for regulatory decision making

In the discussion section, the discrepancy between the ability to replace modules while maintaining consistency and standardization will be addressed.
All but two users indicated that they would use a feature that evaluated water level fluctuations in assessments by modifying depth inputs in scenarios. Users were also asked if there were other standards they would like to see developed. A small number of suggestions were provided and they included:

- A feature that would show how species such as gobies and carp could benefit or be hindered by alteration
- Incorporate flexibility for users to add as desired / required for a project
- Bathymetry, wave regime, littoral transport
- Near and medium term climate change scenarios based on ensembles of General circulation models (GCMs) and emissions scenarios should be available to allow users to view their analyses in a long term context

3.5 RUNNING HEAT

Figure 8 shows that the majority of users (80%) felt that both regulators and proponents should be running HEAT. This is consistent across all organizations.

Several comments were provided to suggest that if the proponent runs the tool, the results need to be evaluated by regulators. Many felt that it was not the role of the regulator to run scenarios but to audit results to ensure consistency. Approximately two-thirds of the users felt that results of an analysis should be posted on a public registry once a regulatory decision is made. Users also generally agreed that anyone should be allowed to use HEAT for research or scientific purposes.

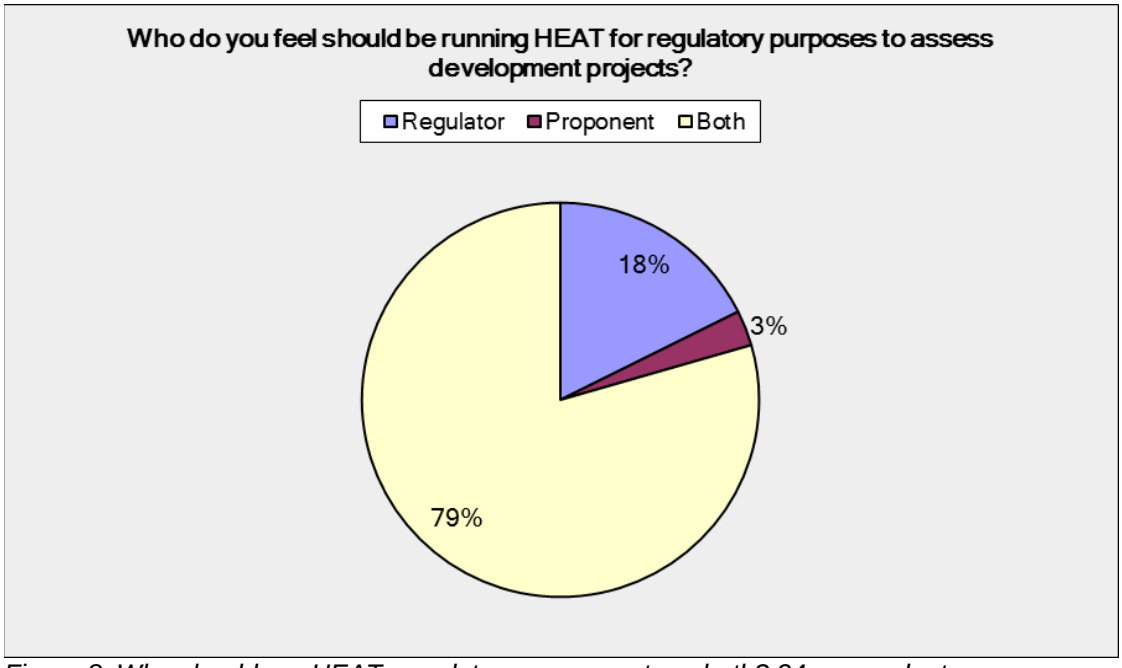

Figure 8. Who should run HEAT, regulators, proponents or both? 34 respondents

The results of the survey indicate that there remains interest in using the HAAT in its new form as the Habitat / Ecosystem Assessment Tool. With the addition of new variables such as water level fluctuations and temperature, users will be able to assess a variety of projects with more accuracy.

3.6 PRIORITIES OF DEVELOPMENT

During the discussion at the workshop, a list was compiled of all eighteen functions or features that users would like to see included in the HEAT application:

- Temperature
- Water levels
- Water Quality (TDS, DO, contaminants, pH, etc.)
- Fetch
- Ice cover
- Connectivity
- Seasonality (O2)
- Productivity

- Increase # Condition Factors (CFs)
- Uncertainty Analysis
- Time lags
- Customize preferences
- Define Alternate suitability tables
- Alternative Calculation Methods
- Habitat weighting
- Map output
- Data exchange
- Increased Habitat Layers

A pair-wise ranking was used to establish the relative priorities for inclusion of these functions in HEAT and the results of the ranking are shown in Figure 9. In pair-wise ranking each possible combination of two functions is compared with the evaluation for each pair being to identify which would be chosen if only one of the pair could be included. Each member of the pair is scored at the same time with a value of 1 being recorded in the row of the option chosen (in the column of the other) and a 0 in the row of the rejected option (under the column for the other). Scores were entered by consensus of the participants. For the few instances in which consensus could not be reached, equal values of 0.5 were scored for each option. The process thus needs to compare only the combinations presented in the upper half of the scoring matrix. Diagonal entries, corresponding to the intersection of rows and columns for single options are disregarded.

	Temperature	Water levels	Water quality	Fetch	Ice cover	Connectivity	Seasonality (O2)	Productivity	Increase # CFs	Uncertainty	Time lag	Customize preferences	Alternate suitability	Calc methods	Habitat weighting	Map output	Data exchange	Increase Layer	Score
Temperature	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	16
Water levels	0	0	1	1	1	1	1	1	0.5	1	1	1	1	1	0	1	1	0	13.5
Water Quality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fetch	0	0	1	0	1	1	1	0	0	1	1	1	1	1	0	1	1	0	11
Ice cover	0	0	1	0	0	0	1	0	0	0	0	1	1	1	0	0	0	0	5
Connectivity	0	0	1	0	1	0	1	0	0	0	0.5	1	1	1	0	1	1	0	8.5
Seasonality (O2)	0	0	1	0	0	0	0	0	0	0	1	1	1	1	0	0.5	1	0	6.5
Productivity	0	0	1	1	1	1	1	0	0	1	1	1	1	1	0	1	1	0	12
Increase # CFs	0	0.5	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	0	13.5
Uncertainty	0	0	1	0	1	1	1	0	0	0	1	1	1	1	0	1	1	0	10
Time lag	0	0	1	0	1	0.5	0	0	0	0	0	1	1	1	0	1	1	0	7.5
Customize preferences	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0.5	0	2
Alternate suitability	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	1	1	0	5
Calc methods	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	4
Habitat weighting	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	16
Map output	0	0	1	0	1	0	0.5	0	0	0	0	0.5	0	0	0	0	0	0	3
Data exchange	0	0	1	0	1	0	0	0	0	0	0	0.5	0	0	0	1	0	0	3.5
Increase Layer	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	16

Figure 9. Pair-wise value ranking of expanded functions.

Based on the results of the pair-wise value comparisons, the ranking of the 18 options is presented in Table 1.

Table 1. Priority Ranking of expanded functions desired in HEAT based on survey results. Functions or features ranked at 1 are highest priority, score indicates pair-wise value comparison scores.

Function	Rank	Score	Function	Rank	Score
Temperature	1	16.	Time lag	10	7.5
Increase # of Layers	1	16.	Seasonality (O2)	11	6.5
Habitat weighting	1	16.	Ice cover	12	5
Water levels	4	13.5	Alternate suitability	12	5
Increase # CFs	4	13.5	Calculation methods	14	4
Productivity	6	12	Data exchange	15	3.5
Fetch	7	11	Map output	16	3
Uncertainty	8	10	Customize preferences	17	2
Connectivity	9	8.5	Water Quality	18	0

Based on the survey results, users identified the most important future features to include in HEAT were temperatures and water levels. Twenty-five users indicated that they were interested in attending a follow up workshop. Furthermore, guidance would be needed to define water levels to using policy that defines high water mark. It would also be necessary to make decisions regarding how managed water levels may behave differently than small inland lakes. And finally, it would be necessary to fill missing gaps in data for northern habitat preferences that have limited information.

4.0 DISCUSSION

Past, current and future potential users of the Habitat Ecosystem Assessment Tool were asked to participate in the survey, 37 surveys were completed; however, participants had the ability to skip questions they chose not to answer. This may have contributed to some minor sampling bias towards those participants who were more familiar with the Tool or had job functions that were more closely in line with HEAT.

During the progress, it was found that there was some discrepancy between users wanting the ability to replace modules while also while maintaining consistency and standardization of the Tool. It was found that mostly consultants working with the Tool wanted more flexibility, while those working within FPP, assessing proposals wanted a standardized Tool for their assessment and for policy purposes. A possible compromise for this conflict may be that consultants wishing to replace modules must submit justification with their proposal that would disclose why and how the module has been altered. Thus, it would still be possible to have a consistent and standardized Tool, in which the exception (replacement of a module) would have to be justified in writing and submitted as a proposal. This would apply also for modifying default choices within the Tool.

There was some discussion during both the workshop and the survey regarding some user difficulties in understanding and using the Tool. This was largely due to the lack of training available and provided to the users at the time. Since the time the workshop and surveys were held, the Tool has been made into an online platform and is far more accessible to users. Also, in-person training, help videos, and a guidance manual have been created. It is hoped that these efforts, as the model complexity is

advanced through its development, will alleviate some of the negative or problematic use of the Tool.

5.0 CONCLUSIONS

The workshop and survey results showed the importance of the tool as well as its valued and essentiality for both the private sector and regulators. Therefore, continual update and support will be necessary to support its users. It was identified that priority upgrades to HEAT include temperature and water level scenario capabilities, updated habitat suitabilities, expansion to a national scope and the inclusion of a river module.

In order meet the growing demands of users, base information and habitat suitabilities should be reviewed to incorporate new information and research that has been gathered since the initial development of the Tool, as the core database has not been changed since its creation, for example the addition of new or emerging species (such as the expansion of round goby in the Great Lakes). There will also be the requirement for the assignment of species to the various guilds (life history characteristics) and an updating of habitat preferences.

Future direction for the tool will include:

- Adding temperature metrics and water level scenario guidance
- Developing methods for scaling weighted suitable area to fisheries productivity or potential yield
- Relate the metrics to fisheries objectives of the location (well-defined for the Great Lakes)
- Linking lake and river HEAT, and equate habitat/productivity in the two for trade offs
- Expanding to National fish databases to extend application geographically

Developing HEAT further enables the implementation of science advice that will support the new Fisheries Act. Its application is also sought after in area-based evaluation and management in Areas of Concern. Habitat supply calculations in HEAT will continue to include pathways of effects endpoints and will produce outcomes that inform environmental response approaches. To extend the Lake HEAT to other ecoregions, we will finalize a gap analysis of information required to complete regional Lake HEAT datasets on fishes and their habitat requirements by life stage. We will scope the development of River HEAT and begin the implementation of river models as HEAT toolbox components. We will continue to review Lake HEAT functionality and applicability with proponents.

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Appendix A Survey Questions

General Information

Q1 Where do you work?

Q2 What is your job title (optional)?

Q3 Are you a (if you are a current user and plan to use HEAT in the future, check Current HEAT user):

- Past HEAT user
- Current HEAT user
- Future / Potential HEAT user

Past Users

Q4 If you are a past user, why do you no longer use HEAT? (check all that apply)

- New role / job
- Not required for proposals / referrals
- Difficult to use
- Problems in use

Q5 You answered that the program is difficult or problematic to use. What changes could be implemented to make you want to use the tool again?

Past or Current Users

Q6 Are you the sole user of your user ID/password for HEAT in your office?

Q7 If No, how many others share the password?

Q8 What do you like about HEAT?

Q9 Do you have any issues with the current tool? Are there any improvements you would like to see in the tool?

Functionality of HEAT

Q10 What delivery format would you prefer for HEAT?

- Web-based Tool
- Downloadable Tool

Q11 What kind of spatial functionality would you like to have as part of the tool, if any? (e.g. mapping suitabilities, GIS inputs, AutoCAD imports, etc)

Q12 What support materials would you like to see available on the HEAT website?

- Manual
- Training and Support
- Example scenarios
- Frequently Asked Questions section
- Other (please specify)

Q13 Would you like to be able to share data files through mechanisms such as a remote server or the "cloud" when using the HEAT tool?

Q14 Do you have any comments or concerns regarding sharing data files (e.g. privacy, security, proprietary issues, protected access, administration, etc)?

Existing Features and Modules of HEAT

Q15 What might you use this tool for (check all that apply)?

- Development project assessment – Lake
- Development project assessment – River
- Impact assessment (water regulation, climate change modeling, etc)
- Population modeling (including Species at Risk and fisheries)
- Critical habitat (Species at Risk)
- Invasion Ecology
- Restoration activity assessment
- Other (please specify)

Q16 Please indicate the features within the Definition Module of the Tool that you have changed to customize your scenarios?

- Location
- Species Group
- Scenarios
- Condition Factor (within a Scenario)
- Habitat Types

Q17 Please indicate the features within the Location Module of the Tool that you have changed to customize your scenarios.

- Species Lists
- Using Tertiary Watershed Species Lists

Q18 Are you aware of the following Modules?

- Uncertainty Analysis Module
- Temporal Analysis Module

Q19 In the Reports Module, are you aware of the following report options?

- Species Suitabilities
- Group Suitabilities
- Composite Group Suitabilities
- Habitat Supply Areas
- Habitat Supply Areas by Class
- Habitat Supply Composite Areas
- Habitat Supply Areas Summary
- Species Suitable Areas
- Group Suitable Areas
- Composite Group Suitable Areas
- Weighted Suitable Areas
- Areas and WSA by Area Type

Q20 Have you used the Print Module?

Future Modules in HEAT

Q21 In the HEAT tool, we will be adding temperature into the list of variables used in assessment.

- Is this an important addition to the traditional assessments?
- Are there other variables you would like included?
- Would you like to have flexibility in specifying new variables and their associated suitabilities?

Q22 Additional variables that have been considered include habitat connectivity/accessibility and adjacent habitat. Do you have any other ideas?

Q23 Would you like to be able to extend, modify or replace existing suitability models in the Tool?

Q24 We will be providing standards for evaluating water level fluctuations in assessments by modifying depth inputs in scenarios. Would you use this feature?

Q25 Are there other standards that you would like to see developed? If so, please describe in the space below.

Running HEAT

Q26 Who do you feel should be running HEAT for regulatory purposes to assess development projects?

- Regulator
- Proponent
- Both
- Comment

Q27 Once a regulatory decision has been made, should the results of the analysis be posted on a public registry?

Q28 Should anyone be allowed to use HEAT for research or scientific purposes?

Final Questions

Q29 If you have any additional comments on a topic we have not raised, please provide them below.

Q30 Would you be interested in attending a focus group workshop (to be held in February, 2013) to help direct HEAT development and vet new functionality and concepts?

Q31 If yes, please provide us with your email address (this will not be published). Your answers will not be associated with this email address and will be kept private.