



The 2nd International Conference on  
**Sustainability in Hydropower 2023**  
-Ecological mitigation, best practises and governance

**HyPEAK**  
research network

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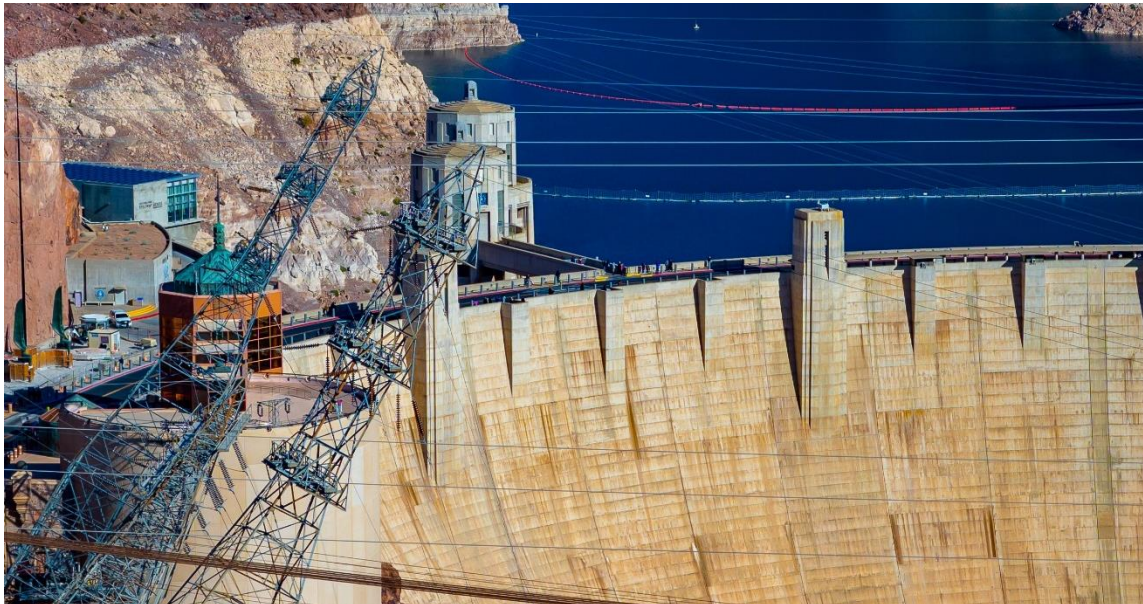


**IHG**

Institute of  
Hydrobiology and Aquatic  
Ecosystem Management

# Research priorities in hydropeaking

**Daniel S. Hayes**, Maria Cristina Bruno, Maria Alp, Isabel Boavida, Ramon J. Batalla, Maria Dolores Bejarano, Markus Noack, Davide Vanzo, Roser Casas-Mulet, Damian Vericat, Mauro Carolli, Diego Tonolla, Jo H. Halleraker, Marie-Pierre Gosselin, Gabriele Chiogna, Guido Zolezzi, Terese E. Venus

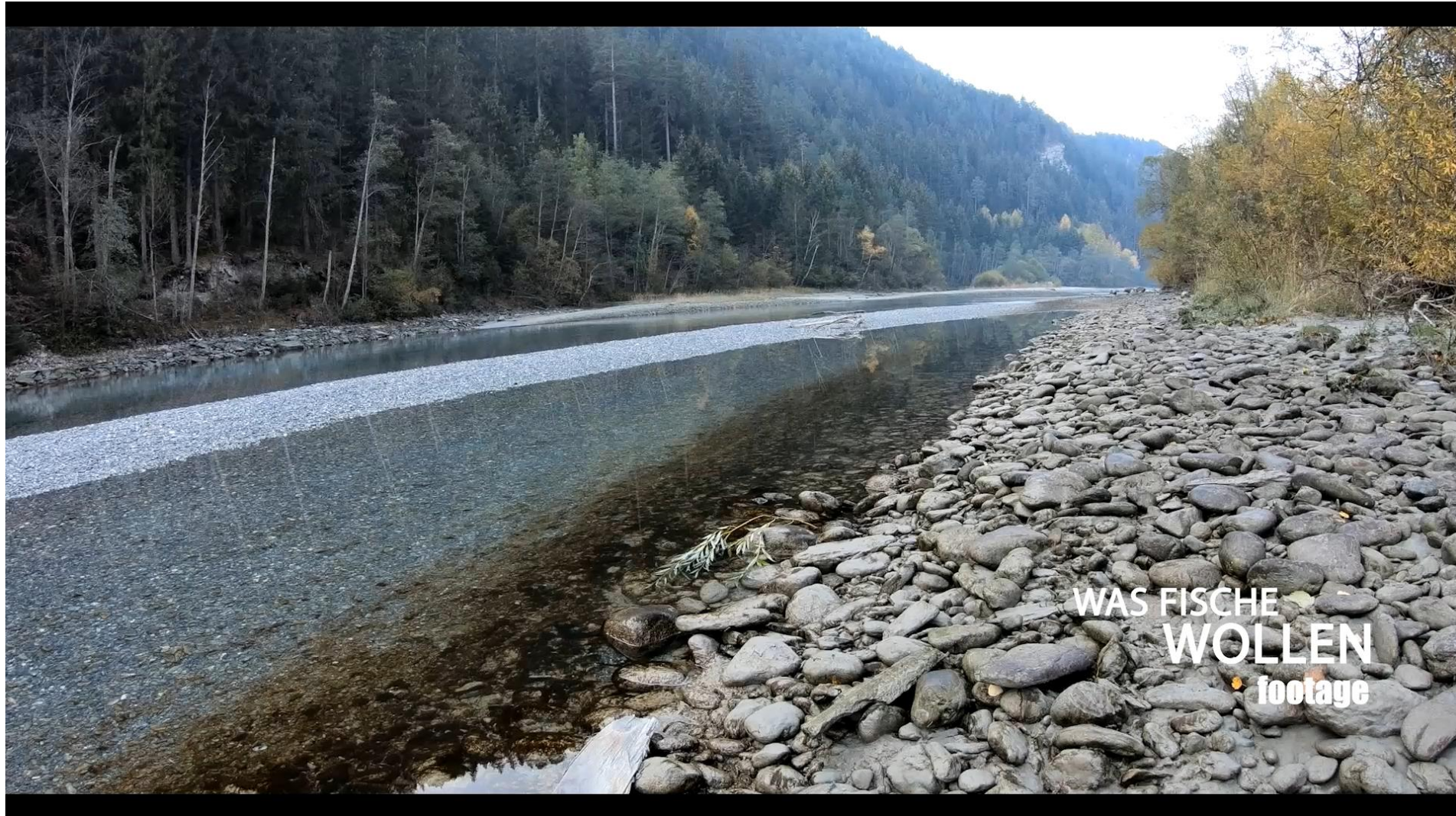


# Flexible hydropower and the energy system



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# Turbine operations and river flows



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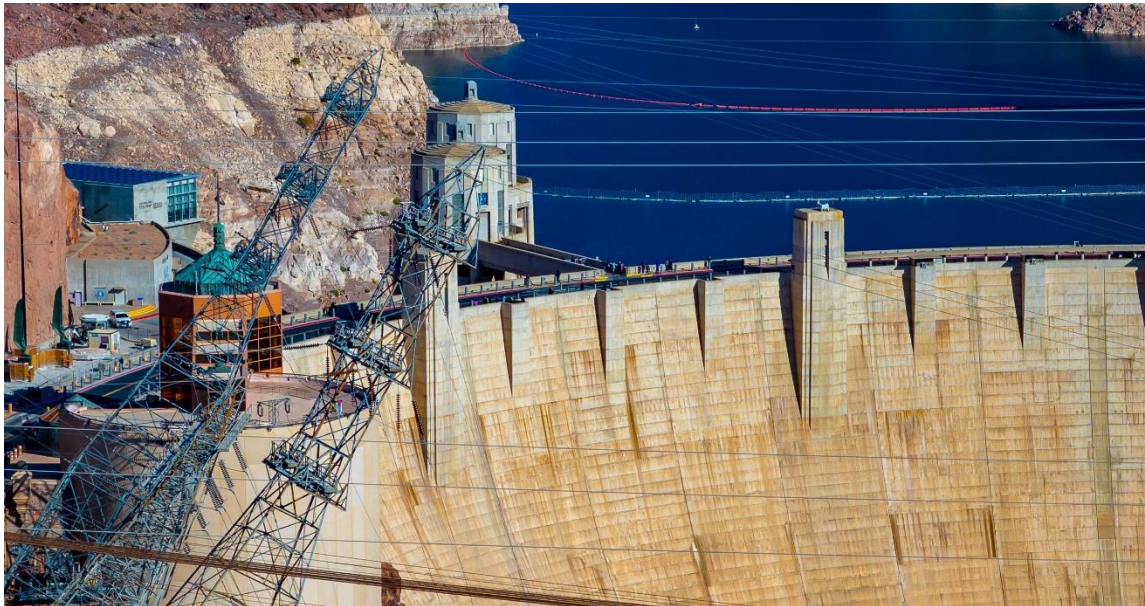
# The controversy of hydropower



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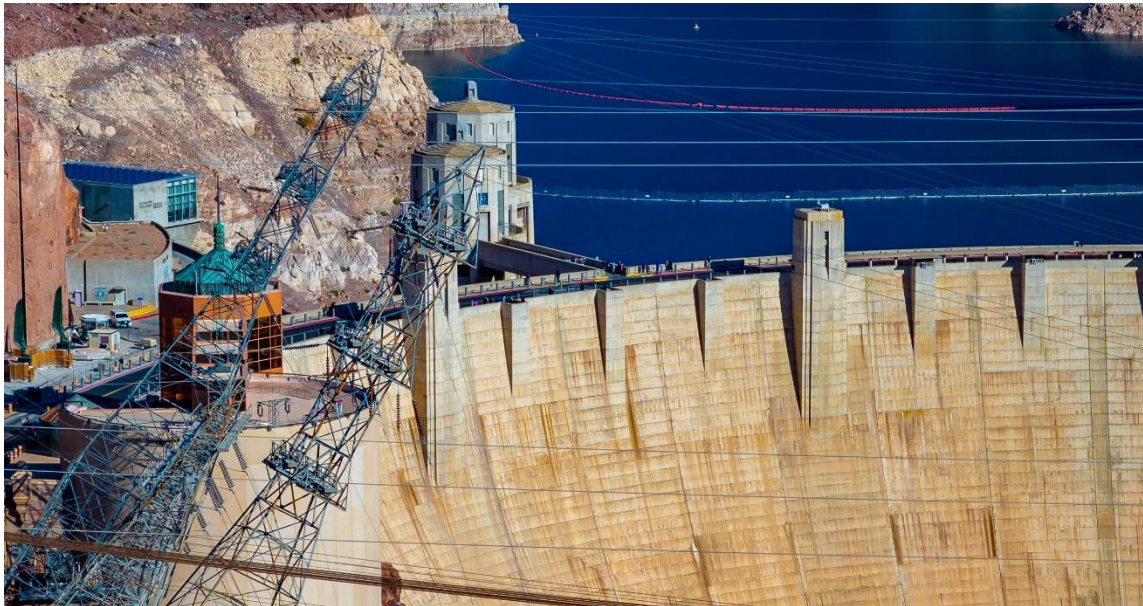


# How can we improve sustainability of peaking hydropower?





# What are the most pressing questions?



# The identification of 100 ecological questions of high policy relevance in the UK

WILLIAM J. SUTHERLAND,<sup>1</sup> SUSAN ARMSTRONG-BROWN,<sup>2</sup> PAUL R. ARMSWORTH,<sup>3</sup> TOM BRERETON,<sup>4</sup> JONATHAN BRICKLAND,<sup>5</sup> COLIN D. CAMPBELL,<sup>6</sup> DANIEL E. CHAMBERLAIN,<sup>7</sup> ANDREW I. COOKE,<sup>8</sup> NICHOLAS K. DULVY,<sup>9</sup> NICHOLAS R. DUSIC,<sup>10</sup> MARTIN FITTON,<sup>11</sup> ROBERT P. FRECKLETON,<sup>12</sup> H. CHARLES J. GODFRAY,<sup>13</sup> NICK GROUT,<sup>14</sup> H. JOHN HARVEY,<sup>15</sup> COLIN HEDLEY,<sup>16</sup> JOHN J. HOPKINS,<sup>17</sup> NEIL B. KIFT,<sup>18</sup> BRIAN OLIVE,<sup>19</sup> SHARON SMITH,<sup>20</sup> SPRAY DEREK



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## One hundred priority questions for landscape restoration in Europe

Nancy Ockendon<sup>a,b,\*</sup>, David H.L. Thomas<sup>a</sup>, Jordi Cortina<sup>c</sup>, William M. Adams<sup>d</sup>, Toby Boris Barov<sup>f</sup>, Luigi Boitani<sup>g</sup>, Aletta Bonn<sup>h,i,j</sup>, Cristina Branquinho<sup>k</sup>, Michael Brombach<sup>l</sup>, Charles Burrell<sup>m</sup>, Steve Carver<sup>n</sup>, Humphrey Q.P. Crick<sup>o</sup>, Beatriz Duguay<sup>p</sup>, Sue Everett<sup>q</sup>, Bart Fokkens<sup>r</sup>, Robert J. Fuller<sup>s</sup>, David W. Gibbons<sup>t</sup>, Ramaz Gokhelasvili<sup>u</sup>, Cy Griffin<sup>v</sup>, Duncan J. Halley<sup>w</sup>, Paul Hotham<sup>x</sup>, Francine M.R. Hughes<sup>y</sup>, Alexandros A. Karamanlidis<sup>z</sup>, Chris J. McOwen<sup>aa</sup>, Lera Miles<sup>ab</sup>, Roger Mitchell<sup>ac</sup>, Michael R.W. Rands<sup>ac</sup>, Jeremy Roberts<sup>ad</sup>, Christopher J. Sandom<sup>ae</sup>, Jonathan W. Spencer<sup>af</sup>, Erica ten Broeke<sup>ag</sup>, Eleanor R. Tew<sup>b</sup>, Chris D. Thomas<sup>ah</sup>, Anastasiya Timoshyna<sup>ai</sup>, Richard K.F. Unsworth<sup>aj</sup>, Stuart Warrington<sup>ak</sup>, William J. Sutherland<sup>b</sup>

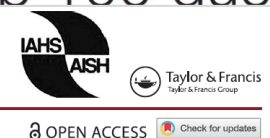
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Journal of Ecology 2013, 101,

# Identification of 100 fundamental ecological questions

William J. Sutherland<sup>1</sup>, Robert P. Freckleton<sup>2</sup>, H. Charles J. Godfray<sup>3</sup>, Steven R. Beissinger<sup>4</sup>, Tim Benton<sup>5</sup>, Duncan D. Cameron<sup>2</sup>, Yohay Carmel<sup>6</sup>, David A. Coomes<sup>7</sup>, Tim Coulson<sup>8</sup>, Mark C. Emmerson<sup>9</sup>, Rosemary S. Hails<sup>10</sup>, Graeme C. Hays Dave J. Hodgson<sup>12</sup>, Michael J. Hutchings<sup>13</sup>, David Johnson<sup>14</sup>, Julia P. G. Jones<sup>15</sup>, Matt J. Keeling<sup>16</sup>, Hanna Kokko<sup>17</sup>, William E. Kunin<sup>18</sup>, Xavier Lambin<sup>14</sup>, Owen T. Lew Yadvinder Malhi<sup>19</sup>, Nova Mieszkowska<sup>20</sup>, E. J. Milner-Gulland<sup>21</sup>, Ken Norris<sup>22</sup>, Albert B. Phillimore<sup>23</sup>, Drew W. Purves<sup>24</sup>, Jane M. Reid<sup>14</sup>, Daniel C. Reuman<sup>21,25</sup>, Ken Thompson<sup>2</sup>, Justin M. J. Travis<sup>14</sup>, Lindsay A. Turnbull<sup>26</sup>, David A. Wardle<sup>27</sup> and Thorsten Wiegand<sup>28</sup>



## Twenty-three unsolved problems in hydrology (UPH) – a community perspective

Günter Blöschl<sup>a</sup>, Marc F.P. Bierkens<sup>b</sup>, Antonio Chambel<sup>c</sup>, Christophe Cudennec<sup>d</sup>, Georgia Destouni<sup>e</sup>, Aldo Fiori<sup>f</sup>, James W. Kirchner<sup>g,h</sup>, Jeffrey J. McDonnell<sup>i</sup>, Hubert H.G. Savenijel<sup>j</sup>, Murugesu Sivapalan<sup>k,l</sup>, Christine Stumpff<sup>m</sup>, Elena Toth<sup>n</sup>, Elena Volpi<sup>o</sup>, Gemma Carr<sup>p</sup>, Claire Lupton<sup>q</sup>, José Salinas<sup>r</sup>, Borbála Széles<sup>s</sup>, Alberto Viglione<sup>t</sup>, Hafzullah Aksoy<sup>u</sup>, Scott T. Allen<sup>v</sup>, Anam Amin<sup>w</sup>, Vazken Andréassian<sup>x</sup>, Earl Bardsley<sup>y</sup>, Marlies H. Barendrecht<sup>z</sup>, Alena Bartosova<sup>aa</sup>, Okke Batelaai<sup>ab</sup>, Theresa Blume<sup>ac</sup>, Thom Bogaard<sup>ad</sup>, Pablo Borges de Amorim<sup>ae</sup>, Michael E. Mitja Brilly<sup>af</sup>, Luca Brocca<sup>ag</sup>, Wouter Buytaert<sup>ah</sup>, Attilio Castellarin<sup>ai</sup>, And Yangbo Chen<sup>aj</sup>, Yuanfang Chen<sup>ak</sup>, Peter Chiffard<sup>al</sup>, Pierluigi Claps<sup>am</sup>, Marty Annette Dathe<sup>ao</sup>, Paula C. David<sup>aa</sup>, Felipe P. J. de Barros<sup>ap</sup>, Gerrit de Roo<sup>aq</sup>, Jessica M. Driscoll<sup>ar</sup>, Doris Duethmann<sup>as</sup>, Ravindra Dwivedi<sup>at</sup>, Ebru Eris<sup>au</sup>, Grant Ferguson<sup>aw</sup>, Ennio Ferrari<sup>ax</sup>, Stefano Ferraris<sup>ay</sup>, Benjamin Fersch<sup>az</sup>, Keirnan Fowler<sup>dad</sup>, Boris Gartsman<sup>eee</sup>, Simon Gascoin<sup>ec</sup>, Eric Gaume<sup>ef</sup>, Al Shervan Gharari<sup>eh</sup>, Tom Gleeson<sup>ei</sup>, Miriam Glendell<sup>ek</sup>, Alena Gonzalez B. Salvatore Grimaldi<sup>enn</sup>, A. B. Gupta<sup>ooo</sup>, Björn Guse<sup>e</sup>, Dawei Han<sup>ppp</sup>, David Kate Heal<sup>ts</sup>, Kay Helfricht<sup>uuu</sup>, Mathew Herrnegger<sup>vvv</sup>, Matthew Hipsey<sup>www</sup>, Ladislav Holko<sup>zzz</sup>, Christopher Hopkinson<sup>aaa</sup>, Markus Hrachowitz<sup>ttt</sup>, Tissa Camyla Innocente<sup>aa</sup>, Erkan Istanbuluoglu<sup>ddd</sup>, Ben Jarihani<sup>eee</sup>, Zahra K. Sina Khatami<sup>ddd</sup>, Jens Kiesel<sup>hh</sup>, Mike Kirkby<sup>jjj</sup>, Wouter Knoben<sup>ppp</sup>, Krzysztof

## A consideration emerges

Robert J. Lennox · Jacob W. Brownscombe · Shannon D. Bower · Paul A. Venturelli · M. Potts · Sascha Clark-Danylchuk

# A participatory process for identifying and prioritizing policy-relevant resource management questions in natural resource management: a case study from the UK forestry

GILLIAN PETROKOFSKY<sup>1\*</sup>, NICHOLAS D. BROWN<sup>1</sup>, GABRIEL STEVE WOODWARD<sup>3</sup>, EDWARD WILSON<sup>4</sup>, ANDREW WEATH VICTORIA STOKES<sup>6</sup>, RICHARD J. SMITHERS<sup>7</sup>, MARCUS SANG KAREN RUSSELL<sup>9</sup>, ANDREW S. PULLIN<sup>10</sup>, COLIN PRICE<sup>10</sup>, MICHAEL MORECROFT<sup>11</sup>, MARK MALINS<sup>12</sup>, ANNA LAWREN KEITH J. KIRBY<sup>13</sup>, DOUGLAS GODBOLD<sup>10</sup>, ELISABETH CHARN DAVID BOSHIER<sup>1</sup>, SASHA BOSBEER<sup>15</sup> AND J. E. MICHAEL ARN

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# The top 100 questions of importance to agricultural agriculture

Deline Ashby<sup>3</sup>, Jill Auburn<sup>4</sup>, David Baulcombe<sup>5</sup>, Michael Katrina Brown<sup>10</sup>, Jacob Burke<sup>11</sup>, Hugh Campbell<sup>12</sup>, Kevin belaeere<sup>16</sup>, Gareth Edwards-Jones<sup>17</sup>, Fernando Funes-iffon<sup>20</sup>, Phrek Gypmantisiri<sup>21</sup>, Lawrence Haddad<sup>22</sup>, Siosia 25, Anne-Marie Izac<sup>26</sup>, Monty Jones<sup>27</sup>, Parviz Koohafkan<sup>28</sup>, 21



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# One Hundred Pressing Questions on the Future of Global Fish Migration Science, Conservation, and Policy

Robert J. Lennox<sup>1\*</sup>, Craig P. Paukert<sup>2,3</sup>, Kim Aarestrup<sup>4</sup>, Marie Auger-Méthé<sup>5</sup>, Lee Baumgartner<sup>6</sup>, Kim Birnie-Gauvin<sup>4</sup>, Kristin Boe<sup>7</sup>, Kerry Brink<sup>8,9</sup>, Jacob W. Brownscombe<sup>10,11</sup>, Yushun Chen<sup>12,13</sup>, Jan G. Davidsen<sup>14</sup>, Erika J. Eliason<sup>15</sup>, Alexander Filous<sup>16</sup>, Bronwyn M. Gillanders<sup>17</sup>, Ingeborg Palm Helland<sup>18</sup>, Andriž Z. Horodysky<sup>19</sup>, Stephanie R. Januchowski-Hartley<sup>20</sup>,



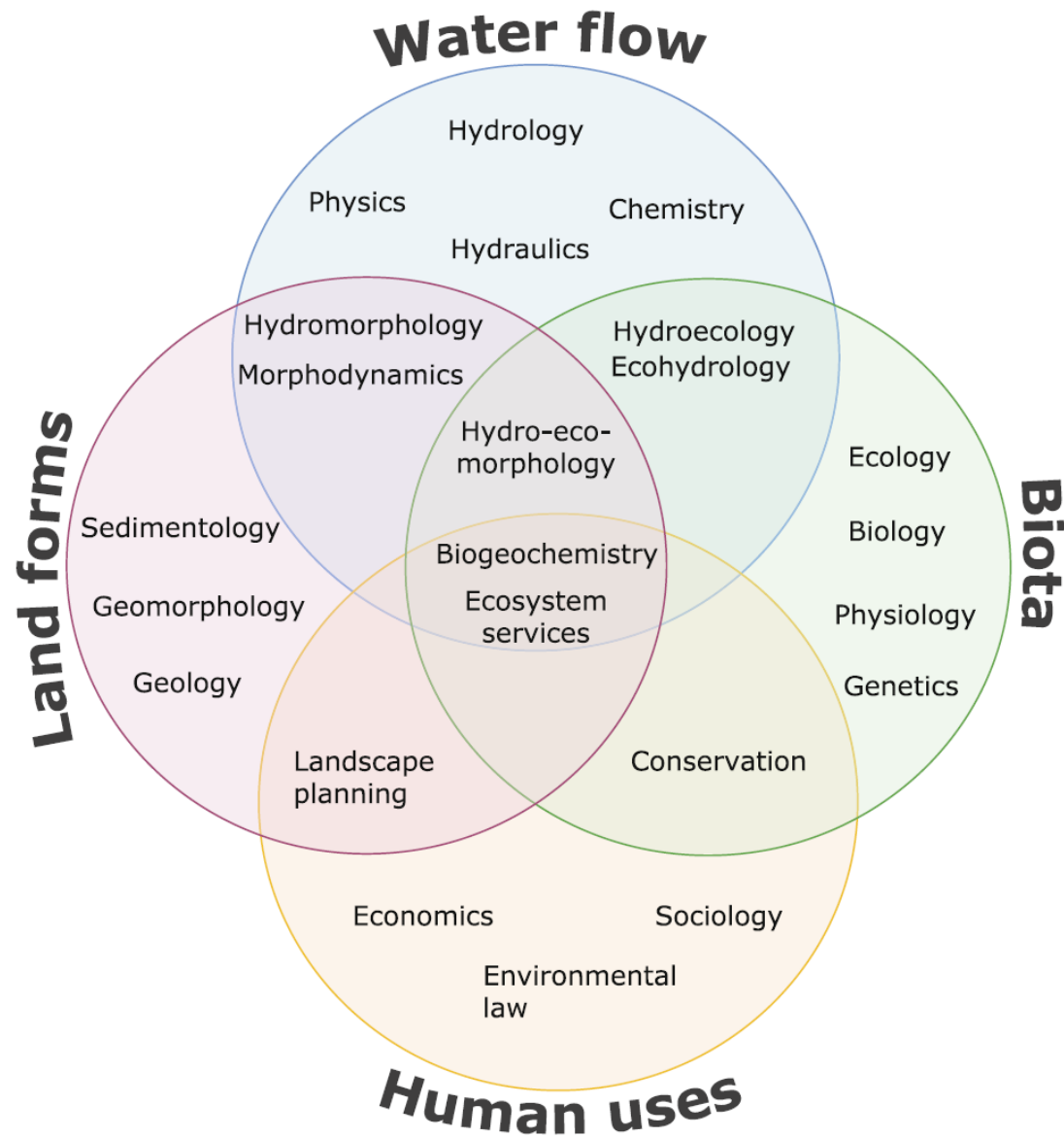
Volume 00 · 2021 10.1093/conphys/coab009



Perspective

# One hundred research questions in conservation physiology for generating actionable evidence to inform conservation policy and practice

Steven J. Cooke<sup>1,\*</sup>, Jordanna N. Bergman<sup>1</sup>, Christine L. Madliger<sup>1</sup>, Rebecca L. Cramp<sup>2</sup>, John Beardall<sup>3</sup>, Gary Burness<sup>4</sup>, Timothy D. Clark<sup>5</sup>, Ben Dantzer<sup>6</sup>, Erick de la Barrera<sup>7</sup>, Nann A. Fanguer<sup>8</sup>, Craig E. Franklin<sup>2</sup>, Andrea Fuller<sup>9</sup>, Lucy A. Hawkes<sup>10</sup>, Kevin R. Hultine<sup>11</sup>, Kathleen E. Hunt<sup>12</sup>, Oliver P. Love<sup>13</sup>, Heath A. MacMillan<sup>14</sup>, John W. Mandelman<sup>15</sup>, Felix C. Mark<sup>16</sup>, Lynn B. Martin<sup>17</sup>, Amy E. M. Newman<sup>18</sup>, Adrienne B. Nicotra<sup>19</sup>, Graham D. Raby<sup>4</sup>, Sharon A. Robinson<sup>20</sup>, Yan Ropert-Coudert<sup>21</sup>, Jodie L. Rummer<sup>22</sup>, Frank Seebacher<sup>23</sup>, Anne E. Todgham<sup>24</sup>, Sean Tomlinson<sup>25</sup> and Steven L. Chown<sup>3</sup>



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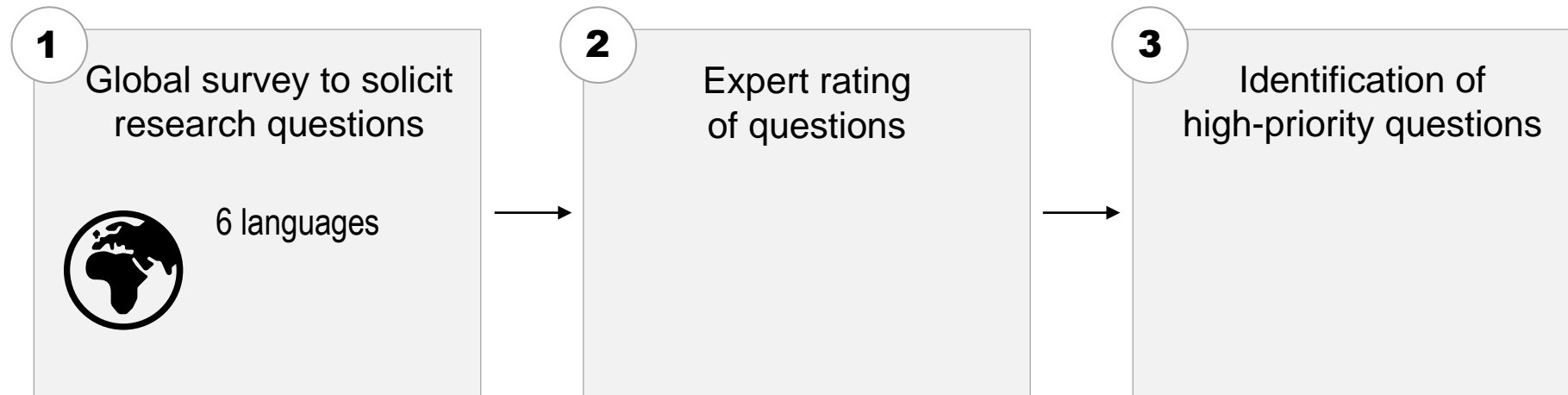
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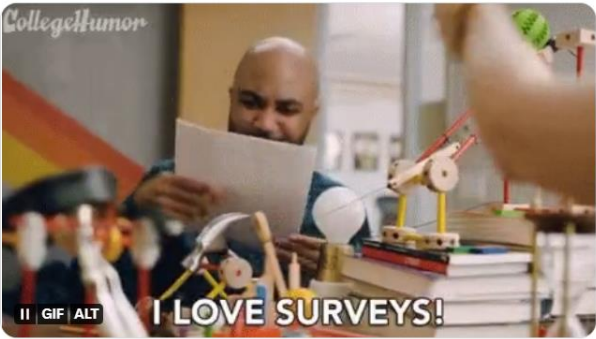
To identify **100 high-priority, policy-relevant questions** in the hydropeaking research and management field.

# Key steps



# Key steps – global survey

**Daniel S. Hayes** @DanielSHayes  
Working on hydropower and loving surveys?  
We've got an exciting one for you.  
[#hydropeaking](#)  
Click here: [ww2.unipark.de/uc/HyPeak/h812/](http://ww2.unipark.de/uc/HyPeak/h812/)  
Less than 2 weeks left to join.  
[@hy\\_peak](#) [@TereseVenus](#) [@TU\\_Muenchen](#) [#ISE2022](#) [#IAHR2022](#)



**Daniel S. Hayes** @DanielSHayes · Dec 27, 2021  
In case you missed it, we decided to extend the hydropeaking survey.  
Join us by the end of January to share your expertise on #hydropeaking research and management.  
[ww2.unipark.de/uc/HyPeak/h812/](http://ww2.unipark.de/uc/HyPeak/h812/)  
Wishing you a prosperous year 2022! 🍀🍀🍀  
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9:23 AM · Jan 19, 2022

## What are unanswered research questions in the field of hydropeaking?

In the field of hydropeaking research, what do you think are unanswered research questions related to each topic? List as many as you feel are relevant.

We encourage you to think widely and also to consult with those outside your particular expertise.

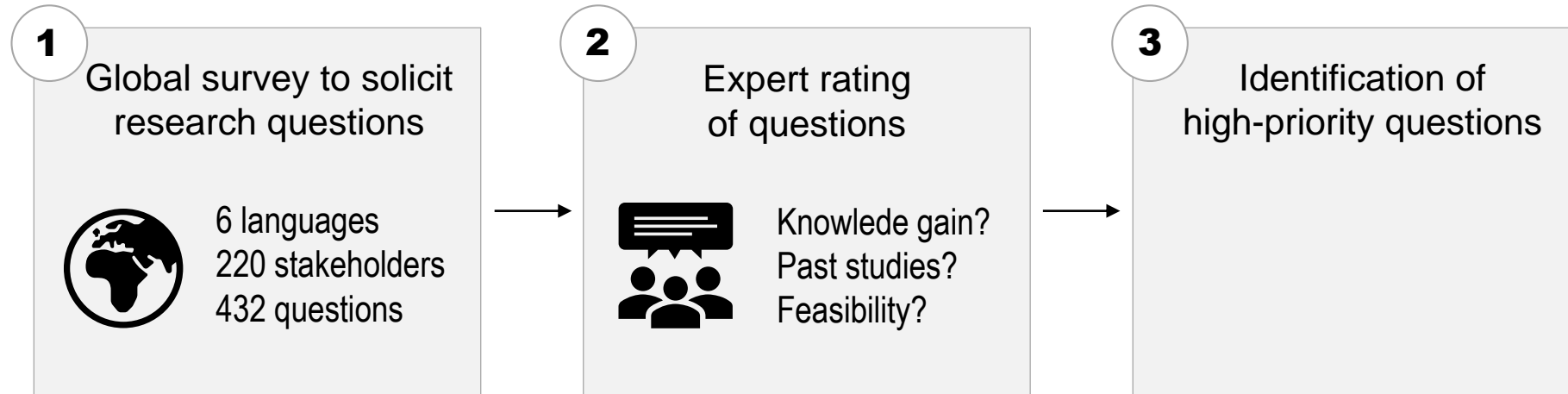
Question 1:

### Hydropeaking hydrology

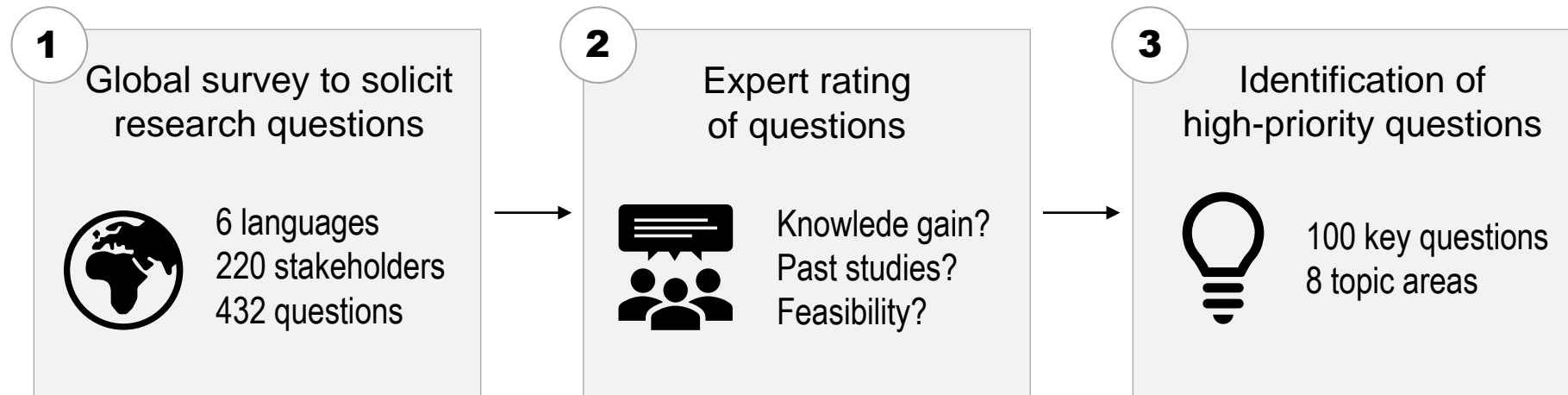
What do you consider the most important and unanswered research questions related to this topic? List as many as you feel are relevant.

*(e.g., regarding wave and flow regime characterization, groundwater interactions, ice formation, spatial localization, tools for impact assessment and mitigation, ...)*

# Key steps



# Key steps



# Topic areas



# Questions – some examples

## Hydrology

- How does the temporal resolution of streamflow (or river stage) data affect assessments of hydropeaking hydrology?

## Physico-chemical properties of water

- How does hydropeaking affect the water quality of the downstream river sections when released from eutrophic reservoirs?

## River morphology and sediment dynamics

- How does hydropeaking affect the riverbed composition in terms of fine sediment content, sorting processes and particle size distribution?

## Ecology and biology

- How does hydropeaking affect riparian or gravel bar invertebrate communities?

## Socio-economic topics

- What respective roles do different stakeholders and institutions play in shaping decision-making about hydropeaking?

## Energy markets

- To what degree does the grid stability and the production flexibility of different countries rely on hydropeaking?

## Policy and regulation

- How can hydropeaking mitigation be more consistently integrated into environmental flows policy?

## Management and mitigation measures

- What are the most effective nature-based mitigation measures (e.g. habitat structures, bedforms, natural ponds) for hydropeaking?

Download all 100 questions

# 100 key questions to guide hydropeaking research and policy

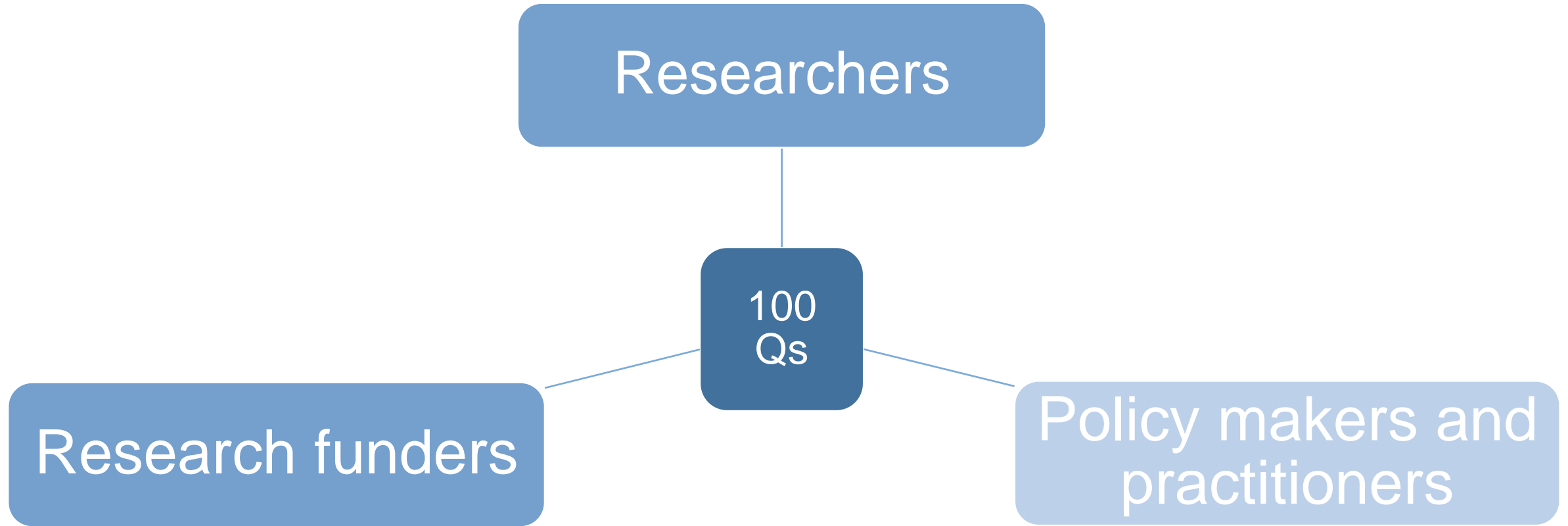
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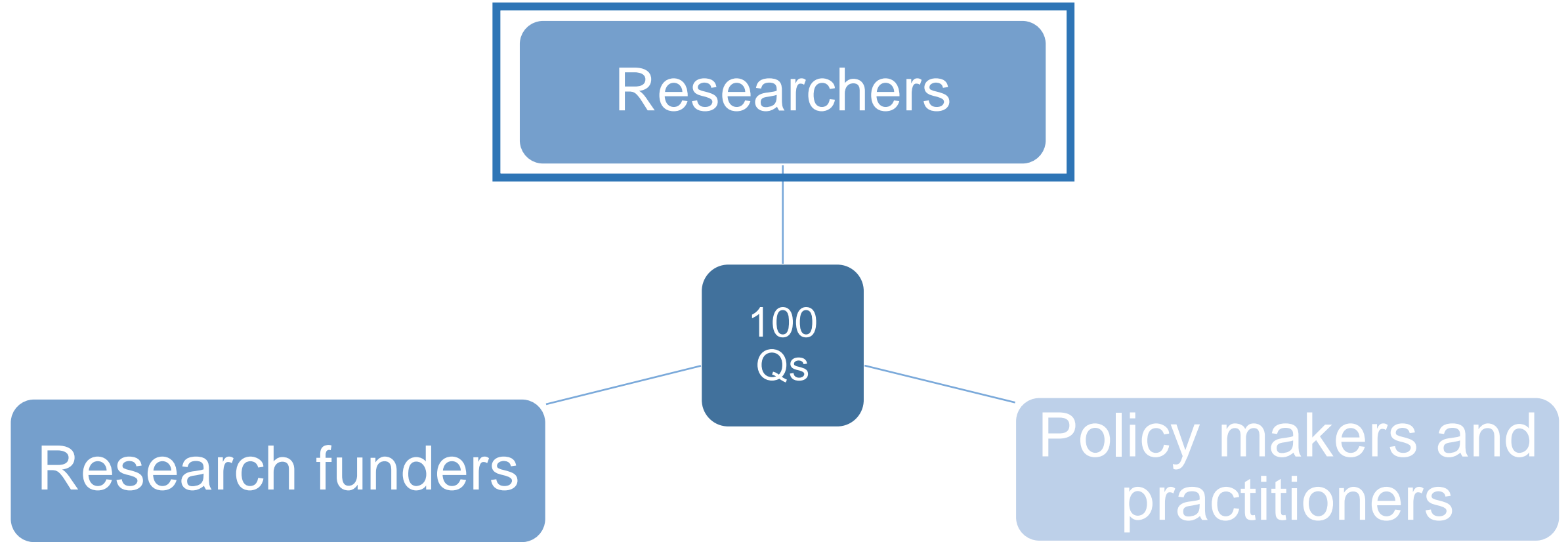




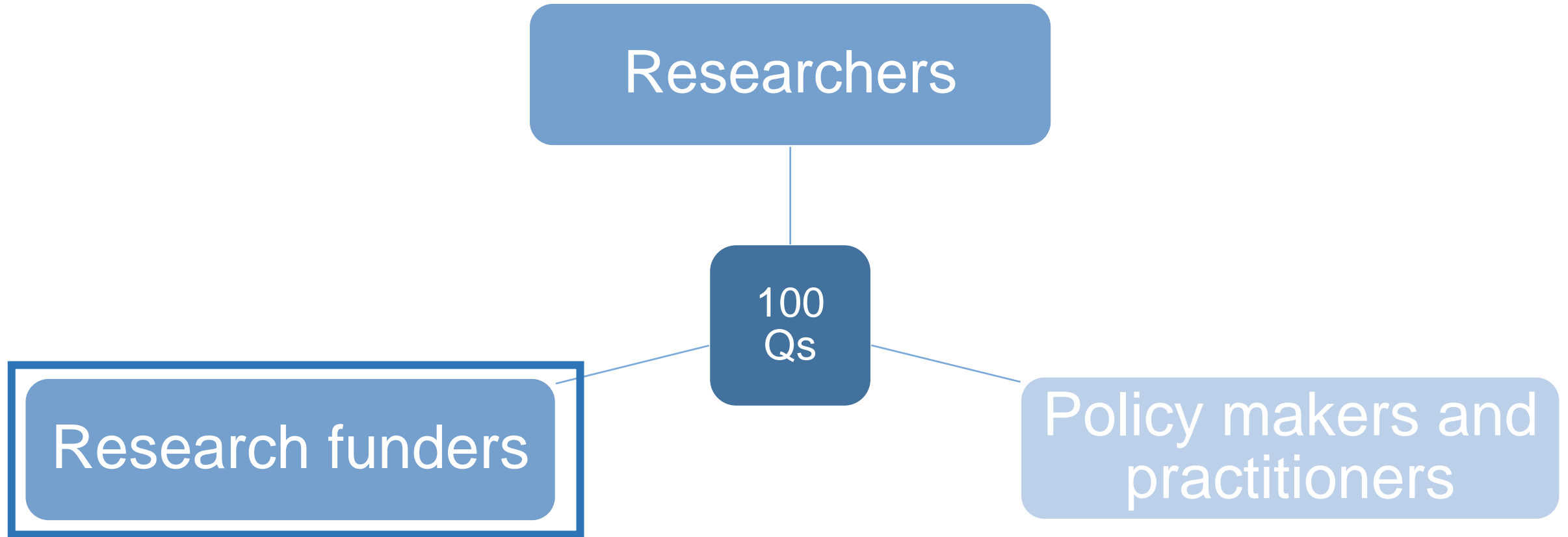
# How to use these questions?



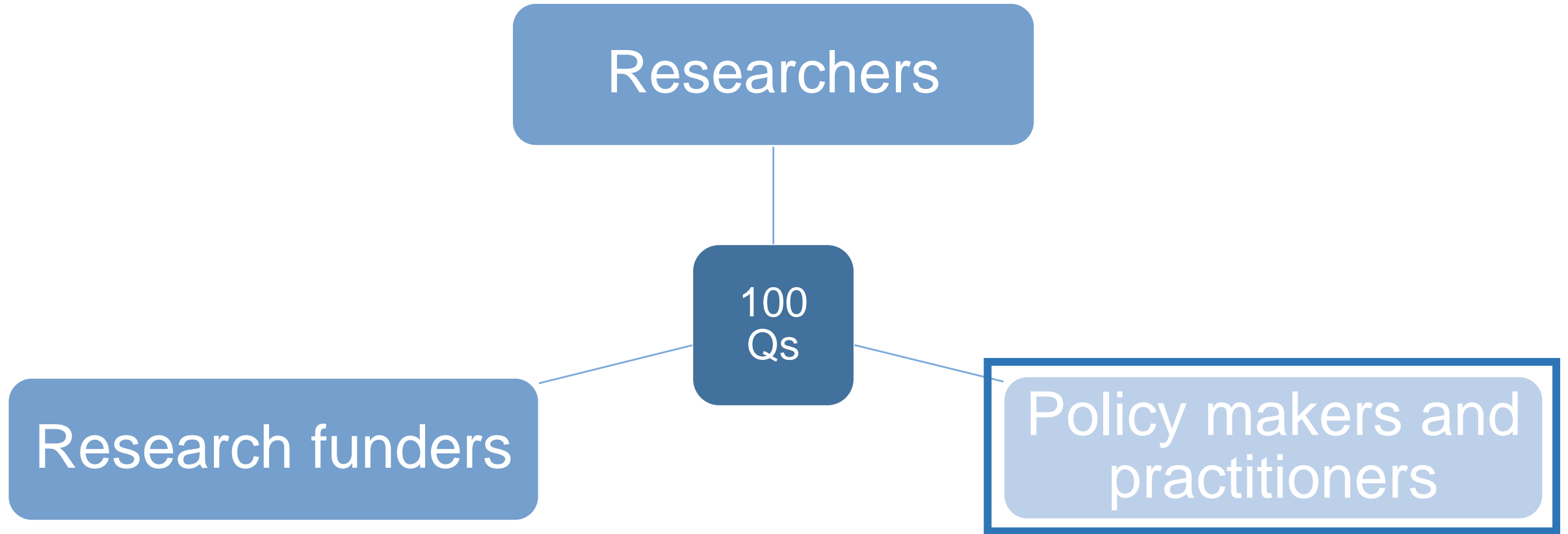
# How to use these questions?



# How to use these questions?



# How to use these questions?



# Conclusions

## 100 key questions to guide hydropeaking research and policy

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# 100 key questions to guide hydroppeaking research and policy

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