Carrying Capacity Assessment: an overview

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RECREATION IN NATURAL AREAS

Evolution of visitors per year in Spanish National Parks (millions of visitors)

Source: EUROPARC-Spain (2017)
RECREATION/TOURISM/SPORT ACTIVITIES IN NATURE
RECREATION IN NATURAL AREAS

• Continuously rising: high demand & offer

• Searching for quality areas ("deep into the forest/mountain/sea"): high capacity to go deep into Nature and impact where other land uses cannot.

• Local/rural development expectations through tourism initiatives.

• A good opportunity for environmental education: All recreation activities in protected areas should include some environmental education contents?
RECREATION IMPACTS

Erosion

Damages on geological heritage
RECREATION IMPACTS

Root exposure

Habitat loss

Trampling/recolection of endangered species
RECREATION IMPACTS

Trampling/outrage

Breeding failure

Feeding
RECREATION IMPACTS

Garbage

Fire risk
FROM CATTLE TO VISITORS...
CARRYING CAPACITY: HISTORY AND CONCEPTS

- Carrying capacity
- Recreation Ecology
- Disturbance research (fauna)

Table 2—The development and major events of recreation ecology research.

<table>
<thead>
<tr>
<th>Approximate time period</th>
<th>Development/event(s)</th>
</tr>
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<tbody>
<tr>
<td>1990s</td>
<td>Refinement of methods; new topics and perspectives</td>
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<tr>
<td>1980s</td>
<td>Integration with management frameworks</td>
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<tr>
<td>1970s</td>
<td>Period of active research</td>
</tr>
<tr>
<td>1960s</td>
<td>Period of rapidly increasing use and impact</td>
</tr>
<tr>
<td>1940-50s</td>
<td>First scientific studies in the United States</td>
</tr>
<tr>
<td>1930s</td>
<td>First experimental trampling studies in the United Kingdom</td>
</tr>
<tr>
<td>1920s</td>
<td>Early observations and descriptions of the problem</td>
</tr>
</tbody>
</table>

*Partly based on Cole (1987b).

Source: Leung & Marion (2000)
CARRYING CAPACITY: HISTORY AND CONCEPTS

- Early definitions (LaPage, 1963): The number of persons using a given area, in an attempt to maximize present individual satisfaction.

- Conceptual groundwork (Wagar, 1964):
  - Carrying capacity is not an inherent property of a place.
  - Depends on the needs and values of people.
  - Not an absolute value. It can only be defined in relation to some management objectives.
  - The conflict between quality and quantity can be reduced through other management actions: zoning, engineering, persuasion, management of biotic communities…

- Development of contemporary management planning frameworks:
  - Limits of Acceptable Change (LAC) (Stankey et al., 1985).

Source: Cole (2001)
General scheme of contemporary impact management planning frameworks (LAC, VERP, VIM)

![Diagram illustrating contemporary management planning frameworks such as LAC, VIM and VERP.](source: Leung & Marion (2000))
CARRYING CAPACITY: HISTORY AND CONCEPTS

Points of agreement:

- Recreation carrying capacity is not an inherent value; it must reflect value judgments.

- Use limits ("numbers") are means rather than ends: they represent the limits that must be set in order to maintain specified acceptable conditions.

- Decisions must be made about which recreation users and which experiences should be favored in any given place.

- Managers need to make use limitation decisions within the context of a large system perspective.

- Little research taking a regional perspective has been conducted.

Source: Cole (2001)
FROM THEORY TO PRACTICE…

- It’s important not to be lost with concepts and frameworks. Previous points of agreement displayed are the basic key.

- Keep in mind that most of these approaches were designed in USA. Nature, protected areas systems and visitors profiles are different in European countries and European biogeographical regions: Local approaches are needed.

- In addition, carrying capacity studies are good opportunities in a protected area:
  - To know the number, flow and profiles of visitors.
  - To know the most sensible biotic & abiotic elements to recreational activities and their responses to them.
CARRYING CAPACITY:
Maximum visitor level that an area can hold with no impact / the least environmental impact level and the best experience quality for visitors.

- Physical carrying capacity (FCC)
- Ecological carrying capacity (ECC)
- Social/Psychological carrying capacity (PCC)

GLOBAL CARRYING CAPACITY VALUE

ECC → Conditionality
min (FCC, PCC)
**PHYSICAL CARRYING CAPACITY**

- Maximum visitor level that an area can physically hold, related to their public use facilities and services (visitor centers, parkings, trails, recreational areas, beaches…).

- Keep in mind that some facilities and services are linked (i.e. parking areas that surround a visitor center, a trail or a beach).

- For trails, it’s interesting the approach of Cifuentes et al. (1992, 1999):

\[ \sum \left( \frac{DT \times TT}{DG \times TV} \right) \times PG \]

- DT: Total trail length
- DG: Average/optimal distance between visitor groups
- TT: Daily visit time
- TV: Average visit duration
- PG: Average num. of visitors per group
ECOLOGICAL CARRYING CAPACITY

- Maximum visitor level without critical or irreversible environmental impacts.

- What is a critical/irreversible impact?:
  - Legal framework
  - Conservation objectives: management plans
  - Scientific/expert criteria

- In general, the result of ECC could be: ACCEPTABLE, ACCEPTABLE WITH CONDITIONS (some management actions must be applied) or NO ACCEPTABLE.

- In nature, it’s difficult to find clear relationship between visitor intensity and environmental impact level at some areas (i.e. wildlife disturbance). Local studies are required.
ECOLOGICAL CARRYING CAPACITY

- Studies addressed to know better these impacts are essential to run more reliable management measures.

Prediction model of breeding vultures response from visitor activity (CATREG) in Bardenas Reales Natural Park.

<table>
<thead>
<tr>
<th></th>
<th>Standarized coefficients</th>
<th>fd</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic intensity</td>
<td>-0.001</td>
<td>164</td>
<td>0.000</td>
<td>0.996</td>
</tr>
<tr>
<td>Num. visitors/group</td>
<td>0.225</td>
<td>163</td>
<td>1.903</td>
<td>0.174</td>
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<tr>
<td>Visitor behaviour</td>
<td>0.141</td>
<td>170</td>
<td>2.685</td>
<td>0.509</td>
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<tr>
<td>Distance from breeding</td>
<td>0.512</td>
<td>189</td>
<td>7.355</td>
<td>0.000</td>
</tr>
<tr>
<td>colony</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Num. of cars parked</td>
<td>0.532</td>
<td>229</td>
<td>5.392</td>
<td>0.024</td>
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<tr>
<td>Hour of the day</td>
<td>0.550</td>
<td>162</td>
<td>11.558</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Source: www.bardenasreales.es
ECOLOGICAL CARRYING CAPACITY

• Maximum visitor level previous to feel significant crowd level and insatisfaction.

• How to get it?: correlation between visitor intensity and crowd level

• Crowd level finding through surveys
MANAGEMENT MEASURES

I. Reduce use of the entire area
   • Limit number of visitors in the entire area
   • Limit length of stay in the entire area
   • Encourage use of other areas
   • Require certain skills and/or equipment
   • Charge a flat visitor fee
   • Make access more difficult throughout the entire area

II. Reduce use of problem areas
   • Inform potential visitors of the disadvantages of problem areas and/or advantages of alternative areas
   • Discourage or prohibit use of problem areas
   • Limit number of visitors in problem areas
   • Encourage or require a length-of-stay limit in problem areas
   • Make access to problem areas more difficult and/or improve access to alternative areas
   • Eliminate facilities or attractions in problem areas and/or improve facilities or attractions in alternative areas
      - Establish differential skill and/or equipment requirements
      - Charge differential visitor fees

III. Modify the location of use within problem areas
   • Discourage or prohibit camping and/or stock use on certain campsites and/or locations
   • Encourage or permit camping and/or stock use only on certain campsites and/or locations
   • Locate facilities on durable sites
   • Concentrate use on sites through facility design and/or information
   • Discourage or prohibit off-trail travel
   • Segregate different types of visitors

IV. Modify the timing of use
   • Encourage use outside of peak use periods
   • Discourage or prohibit use when impact potential is high
   • Charge fees during periods of high use and/or high-impact potential

V. Modify type of use and visitor behavior
   • Discourage or prohibit particularly damaging practices and/or equipment
   • Encourage or require certain behavior, skills and/or equipment
   • Teach a wilderness ethic
   • Encourage or require a party size and/or stock limit
   • Discourage or prohibit stock
   • Discourage or prohibit pets
   • Discourage or prohibit overnight use

VI. Modify visitor expectations
   • Inform visitors about appropriate uses
   • Inform visitors about conditions they may encounter

VII. Increase the resistance of the resource
   • Shield the site from impact
   • Strengthen the site

VIII. Maintain or rehabilitate the resource
   • Remove problems
   • Maintain or rehabilitate impacted locations

Source: Cole and others (1987).
AN EXAMPLE: A PERIURBAN PARK IN THE BASQUE COUNTRY

**Protected Area of Txingudi**
(Gipuzkoa, Spain)

- 160, 82 has.
- SAC ES2120018 Txingudi-Bidasoa
- SPA ES0000243 Txingudi
- Ramsar wetland

Hondarribia:
16.950 inhab.

Hendaia (France):
16.783 inhab.

Irun:
61.608 inhab.

Ecological Park of Plaiaundi
(24 has.)
AN EXAMPLE: A PERIURBAN PARK IN THE BASQUE COUNTRY

Ecological Park of Plaiaundi

- International importance for bird migration
- 7 habitats of Directive 92/43/CEE
- 35,000 visitors/year
- Visitor center / recreational area
- Birdwatching observatories
- Trails
- Parking area
- Sports center (relocation pending)
AN EXAMPLE: A PERIURBAN PARK IN THE BASQUE COUNTRY

- Physical (applying Cifuentes method to trails): 905 visitors/day
- Ecological: ACCEPTABLE WITH CONDITIONS (natural screens to reduce aquatic birds disturbance)
- Psychological: 165 visitors/day
- GLOBAL: 165 visitors/day

<table>
<thead>
<tr>
<th>Date</th>
<th>Daily num. of visitors</th>
</tr>
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<tbody>
<tr>
<td>01/05/2015</td>
<td>102</td>
</tr>
<tr>
<td>02/05/2015</td>
<td>155</td>
</tr>
<tr>
<td>03/05/2015</td>
<td>157</td>
</tr>
<tr>
<td>11/07/2015</td>
<td>127</td>
</tr>
<tr>
<td>25/07/2015</td>
<td>169</td>
</tr>
<tr>
<td>13/09/2015</td>
<td>216</td>
</tr>
<tr>
<td>04/10/2015</td>
<td>258</td>
</tr>
<tr>
<td>05/10/2015</td>
<td>73</td>
</tr>
<tr>
<td>10/10/2015</td>
<td>166</td>
</tr>
</tbody>
</table>
CONCLUDING REMARKS

• Carrying capacity assessment is an interesting approach to face a classical question: Is my protected area crowded? How much?

• Try to indentify previously what kind of facility/service/activity has problems and focus on it: trails? parking areas? canyoning?...

• Values aren´t “magical numbers”: it´s a mean to introduce strategies and tactics for managing recreation impacts.

• Methods should be flexible enough in order to be adapted to local conditions of protected areas (habitats, species, visitor profiles, management capacity…).

• More European studies and experiences are expected: Do you know any?
EXPERIENCES IN SPANISH PROTECTED AREAS

**National Parks:**
- Cabañeros
- Aigüestortes i Estany de Sant Maurici

**Natural Parks:**
- Hoces del río Riaza
- Moncayo
- Delta del Ebro
- Sierra y Cañones de Guara (canyoning)
- Parque Rural de Teno
- Bardenas Reales de Navarra

**Biosphere Reserves:**
- Urdaibai (in progress)

**Periurban Parks:**
- Espacio Natural Txingudi
- Parque Metropolitano de los Toruños y Pinar de La Algaida

**Other:**
- Cabo de Palos – Islas Hormigas (scuba diving)
- Natural Monument of Praia das Catedrais
- Natural Monument of Bandama (in progress)
REFERENCES:


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THANK YOU FOR YOUR ATTENTION

ONE THING RUNNERS HAVE IN COMMON

THEY ALL TASTE LIKE CHICKEN